

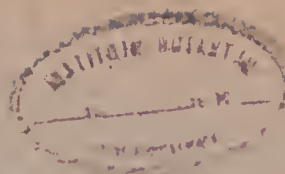
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The BULLETIN contains scientific contributions to, and current information on, the relation of snakes and other poisonous animals to man, with special reference to the highly venomous species of North and Central America, the West Indies, and northern South America. The subject matter covers taxonomy, biology and geographical distribution of species; the economic and public health aspects of the snake-bite problem; the collection of venoms, their composition, properties, and physiological effects; the production of antivenins; and related serological and immunological problems.



Announcement

With this issue, the Antivenin Institute of America begins publication of a Bulletin devoted to a field of scientific research which, heretofore, has received comparatively little attention in this country. While the subject matter at first sight appears limited, yet a wealth of material already available, and many lines of research and experiment now under way, will provide the substance for interesting and important additions to scientific literature.

It is the ambition of the editors to make the Bulletin an authoritative source of information and a suitable medium for the publication of original research and semi-popular articles on all the subjects outlined in the paragraph at the top of this page. It is hoped to make it of value to museum workers, university and college departments of biology, to public health officials and physicians who have occasion to study the public health and therapeutic aspects of the snake-bite problem, and to educators in our medical schools and to immunologists interested in the serological aspects of venoms and antivenins. It is also planned to include in each issue one or more articles written in a simple, semi-popular style, which will interest, not only the specialist, but the nature-lover, camper, tourist, construction engi-

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neer, or others whose work or play brings to them a desire for accurate information on the subject of snakes and other poisonous animals. The Bulletin will, therefore, serve both as an avenue for the communication of scientific facts and as a means of popular education.

The value of such a publication is apparent to interested students who have been impressed by the apparent increase in the number of snake-bites and the number of fatalities resulting therefrom. The problem is assuming considerable importance in certain portions of the United States where snakes abound; and is particularly serious in the tropics and sub-tropics. Large projects for agricultural developments in these regions are often retarded and held back through the difficulty of obtaining and holding immigrants, on account of the fear of venomous reptiles. New agricultural developments usually mean an increase in rodents and other small mammals. With this increase in their food supply, there is, naturally, an increase in the number of venomous snakes, so that the hazards of agricultural operations in the tropics become very real. The Antivenin Institute of America hopes, through the columns of this publication, to contribute to the solution of this problem and thus aid in the conquest of the tropics and in the development of their illimitable resources.

The BULLETIN OF THE ANTIVENIN INSTITUTE OF AMERICA will be issued quarterly, the four issues of the year to constitute one volume. The subscription price is one dollar and a half (\$1.50). Contributions are invited. All articles and communications intended for publication and all books or other publications for review should be sent to the editors, who will arrange for their publication, as far as practical, in the order in which they are received. Twenty-five reprints of all leading articles will be supplied gratis to authors. Additional copies can be furnished at reasonable cost by arrangement in advance.



FIG. 1.--A Typical Banded Rattlesnake (*Crotalus horridus*). By Permission of N. Y. Zoological Society.

1. OCCURRENCE AND HABITS OF OUR POISONOUS SNAKES

By RAYMOND L. DITMARS

Practically every portion of the United States is inhabited by poisonous serpents—although we might accord to a few states in the northeastern corner of this far-flung area the reputation of being nearly or quite free of them. These are the states of Maine, New Hampshire and Vermont. We cannot altogether clear Vermont, as there are occasional reports of rattlers in the southerly portion. The northerly states to the westward are liberally inhabited by rattlesnakes, and these reptiles extend their habitat well into Canada. This condition extends westward to the Pacific Coast. Our southeastern states, warmed by their contact with the Gulf Stream, with thick tangles of river swamps and coastal areas conducive to the existence of reptile life, harbor large numbers of poisonous serpents. Texas, Arizona and New Mexico are very liberally supplied with rattlers. The Pacific states have large numbers of rattlesnakes, while the interior states show “spotty” occurrence, abundant in some areas, moderately so in others—but let us come back East again. The writer doubts if there are any portions of the United States more abundantly supplied with venomous snakes than some areas of Massachusetts, Connecticut, New York, New Jersey and Pennsylvania.

There is one curious thing about the distribution of some species of our poisonous snakes. They are so thoroughly “in our midst.” The writer bears in mind important summering towns of our eastern states where venomous reptiles extend their domains to within a few minutes’ motor ride of Main Street. It is not necessary to go far into the wilds to find several of the venomous species. One may stand on fashionable Riverside Drive in New York City, and without a field glass look northward and across the Hudson to rocky areas inhabited by copperhead snakes. From records at hand we believe that copperhead snakes still exist within the actual northern boundaries of New York City. During the past two years we received more than three dozen large copperheads captured within the city limits of a thriving community about twenty minutes’ motor run from the boundaries of the Bronx.

A detailed description of the distribution of our poisonous reptiles is of practical interest. There are more than a dozen distinct species or “kinds” of rattlesnakes, varying in size from one that is smaller than the average garter snake to the huge and formidable Diamond-back, which attains a length of nearly nine feet, a circumference of about twelve inches and weighs up to fifteen pounds. Throughout the whole northeastern portion of the United States there is but a single species—the Banded or Timber Rattlesnake. In western New York a small rattler—the Massasauga—is occasionally found and becomes rather common in the eastern central states. The timber rattlesnake gives way on the eastern plains to a species of wide distribution—the Prairie Rattlesnake—which again gives way, in approaching the Pacific region, to the Pacific Rattlesnake. Going south, in the East, we find another rattler from about the central portion of North Carolina. This is the diminutive Pygmy Rattlesnake, often called the “Ground” Rattler. The latter term is misleading and inappropriate, as all the rattlers are strictly terrestrial. A bit farther south is the range of the big southern Diamond-back, which attains the greatest length of any rattlesnake in the United States. The Mississippi Valley forms the western boundary of this deadly brute, its place being taken in Texas, thence westward to eastern California, by the big Diamond-back of the arid regions—a close second in size, attaining a length of seven feet or more. Going westward into the habitat of this species, we enter the headquarters of the rattlesnakes of the southwest. At least five species of rattlesnakes are found in Texas, but the southwestern states may “boast” ten or more distinct kinds, among these being the almost white Mitchell’s Rattlesnake, the Red Rattler and the curious Sidewinder. The last never leaves the deserts, and living on soft and yielding sand, has become highly specialized in locomotion, throwing lateral loops of the body, instead of crawling, and thus moving off rapidly in what appears an oblique direction to that in which its head is pointing. With the exception of two species, the rattlers

feed upon warm-blooded animals—mammals and birds. The two species of *Sistrurus*—the Pygmy Rattlesnake and the little Massasauga—feed largely upon frogs, but also upon warm-blooded prey.

All the species of rattlesnakes, large and small, may be immediately distinguished by the unique caudal appendage—the rattle. The amateur naturalist, prospector or farmer is not particular as to the exact species; what he is desirous of knowing is whether a snake is dangerous. The possession of a rattle shows this to be invariably the case.

In the distribution of our poisonous snakes, we have yet to consider the two species of moccasins—the Water Moccasin and the Copperhead Snake (Highland Moccasin, Pilot Snake, Chunkhead, etc.). These belong, as do the rattlers, to the family of Pit Vipers, having a deep pit on each side of the head between the eye and the nostril. Here is a strong character for identification. The Water Moccasin is dull olive, with wide transverse darker bands, and is common in the swamps and sluggish waterways of South Carolina, Georgia, Florida, Alabama and Louisiana—also portions of adjoining states. The Copperhead Snake is pale brown, and crossing this ground color are rich reddish brown bands, usually narrow on the top and very wide on the sides, appearing when examined from above like the outlines of an hour-glass. Texas specimens are rather characteristic in having fewer and much wider bands. The distribution of the copperhead is quite extensive. The species ranges from southern Massachusetts to northern Florida, westward to Oklahoma in the South, to Illinois in the northerly portion of its distribution. It will thus be understood that over the greater portion of the West the only type of poisonous serpent is the rattler.

In our southeastern states, thence along the United States-Mexican boundary, there are two small poisonous serpents of brilliant coloration known as Coral Snakes. They are New World allies of the members of the Cobra family. Both species of the Coral Snakes (*Micrurus*) inhabit the southern part of this country. The common Coral Snake or Harlequin Snake occurs from southern North Carolina to Florida and westward to Texas. It is most abundant in Georgia, Florida,

Alabama and Louisiana. The Sonoran Coral Snake is restricted to Arizona, New Mexico and northern Mexico. Both species are vividly ringed with scarlet, yellow and black—the red and black rings the broadest. Their pattern is wonderfully striking, imparting a really artificial aspect, like a gaudy necklace.

Described in detail, the pattern of the Coral Snakes may be given as broad, alternating rings of red and black, the latter bordered with very narrow rings of yellow. And here we encounter a difficulty: for several harmless snakes “mimic” these species in displaying exactly the same colors, arranged in ring-like fashion. Yet there is one unvarying difference that will always distinguish the dangerous reptile from their innocuous “imitators”: the yellow rings of the poisonous snakes always border the black rings, while among the non-venomous snakes there are pairs of black rings bordering a yellow one.

The Coral Snakes are rather secretive in habits and are often plowed up in the fields. They feed mostly upon small species of innocuous serpents.

Near and frequent contact with humans appears to have influenced the habits of our eastern reptiles. They usually keep close to sheltering holes or crevices, and when disturbed seek to escape as quickly as possible. Or they may try other tactics and remain quite motionless, with the idea of the intruder passing them by unnoticed. They are not nearly so vicious or apt to strike as the poisonous reptiles of the southerly latitudes. Accidentally stepped on or touched by the hand of the careless climber, they will instantly bite, as they are extremely nervous. They are to be seriously reckoned as a hazard in these days of hiking, camping and auto picnicking, as the great majority of our growing legions of outdoor enthusiasts are quite devoid of woodcraft. The fields and woods are filled with novices from the cities, the women wearing silk stockings and knickers, the men shod in low shoes and the children generally running wild. It is quite astonishing that so few accidents are reported in the north, and the condition must in a measure be attributed to the mild temper of the northerly snakes. There is no doubt that many a picnicker has had his unprotected ankles within striking distance of a copperhead, but has blissfully rambled onward.

Neighboring farms, the prowling of domestic animals, near and frequent contact with man, would appear to explain the points outlined and other interesting observations. Motor highways seem to have influenced the prowlings of reptiles. These seem to form barriers to their crossing. Whether or not it is the cement or asphaltum surface or the odor from dropping oil, coupled with the slow disintegration from porous surfaces of exhaust gases, is hard to say, but certain it is that few poisonous serpents are seen these days crossing a motor highway. A few years back they were frequently killed on the roads of dirt or rough macadam. These conditions do not result from any growing scarcity of the reptiles. They are just as abundant as they ever were over wide areas split by motor roads. They have stopped crossing the roads, and the rural police of several states have told the writer they have frequently noted snakes crawling through culverts and think that they prowl along the sides of the roads, under cover—seeking a way to go under the new barrier.

The serpents of our northern and central states, except the open or prairie portions, have other habits differing from those of the South, as they return each year to areas of shattered rock in order to hibernate. They congregate at these specific places or "dens" in considerable numbers and probably come distances of several miles—guided by that strange instinct that prompts the fall migration of birds. As they scatter from the

"dens" in the spring they usually follow the outcrops of the ledges, these offering numerous crevices for escape and shelter, and forming the abode of small rodents, upon which they largely feed. It is this habit of keeping in mind the friendly crevice that prompts them to escape, when frightened, rather than to strike at the intruder.

Conditions are different in the South and over a considerable portion of the mild Pacific region. Rattlesnakes wander over fairly open country or wide areas of sand. They carry no assurance of a nearby sheltering crevice, and when surprised will instantly flash into a fight for life. There is an immediate buzz of the rattle and a stab of poison-conducting fangs if the intruder is within striking distance—the serpent being able to strike slightly over one-half the length of its body. The intent of the snake is to drive an envenomed blow and to escape during the time the enemy is thrown into confusion by the realization of his receiving a poisoned bite. If there is no sheltering vegetation or other means of hiding near by, the rattler may remain coiled and defiant, sounding its warning and ready to repeat the blow. A snake may strike from a clump of greasewood or sage, or from under the broad, low leaves of dwarf palmetto. Such spots should be avoided unless one is shod with heavy canvas or leather leggings. A pair of leather puttees, reaching from the knees over the shoe-tops, offer ninety per cent. protection.

2. STUDIES OF NEOTROPICAL OPHIDIA

IV. A NEW FORM OF CROTALIDÆ FROM BOLIVIA

By AFRANIO DO AMARAL

In a previous publication¹ I described eight subspecies of *Bothrops neuwiedii* Wagler, 1824, which "is, in Brazil, one of the most widespread species of Crotalidæ, its distribution covering almost all the northeastern, central, southeastern, and southern States. Through living in both the tropical and the subtropical regions, and through occurring in different zoögeographical areas, this species really shows noteworthy localized variations chiefly in coloration, form, and disposition of the cephalic and dorsal markings." I then justified the action I was taking as follows: "These variations are so well fixed indeed as

to permit their being assigned subspecific rank.

"Although this is rather a radical view to introduce into the study of Brazilian snakes, still the subdivision of *B. neuwiedii* seems to me perfectly justified by the remarkable fixity of the chromatic characters found in the various groups within this species and by the close relationship existing between such characters and both the geographical and the meteorological features of the corresponding Brazilian areas.

"The subspecies that up to this time I can recognize are the following, which I am nam-

ing after the districts in which they occur: *bahiensis*, *piauhyensis*, *goyazensis*, *minasensis*, *pauloensis*, *mattogrossensis*, *paranaensis*, and *riograndensis*.

"The type of *B. newwiedii* came from Bahia, where it occurs especially in Sincorá, Curralinho, Sitio Novo and other rather low and humid localities south of the Paraguassú River, in the "reconcavo," near the capital of that State. This is the true *Bothrops newwiedii newwiedii*."



FIG. 2.—*Bothrops newwiedii boliviana*, a new Crotalid from Bolivia.

Ever since I have not only been able to confirm those views but recently found that at least a few of those forms overlap one another along their respective boundary lines, as, for instance, *B. newwiedii minasensis* and *B. newwiedii pauloensis*, *B. newwiedii pauloensis* and *B. newwiedii goyazensis*, on the one side, and *B. newwiedii paranaensis*, on the other side. I expect that through the study of more complete series of the remaining subspecies other intermediate forms will also be encountered.

In the meantime I have received for examination two lots of specimens of Bolivian snakes through the courtesy of the late Dr. Douglas Stewart, Director of the Carnegie Museum, and have discovered a complete series of specimens of *Bothrops newwiedii* which do not quite agree with any of the previously recognized forms. The new subspecies may be called

BOTHROPS NEUWIEDII BOLIVIANA subsp. n.

Type.—♀, No. 2728 in the collection of the

Carnegie Museum, sent in 1918 from Buena Vista, Provincia del Sara, Departamento de Santa Cruz de la Sierra, Bolivia, by Dr. J. Steinbach. (Fig. 2.)

Paratypes.—Nos. 1, 4, 34, 35, 38, 40, 46, 49, 54, 55, 58, 60, 61, 67, 68, 69, 119, 120, 122, 123, 2710, 2711, 2712, 2713, 2714, 2715, 2722, 2723, 2724, 2725, 2726, 2727, 2729, 2730, 2731, 2752, 2771, 2772, 2773, 2801, 2802, 2814, 2815, 2819, 2829, 2856, 2857, 2858, 2859, 2877, 2896, 2902, 2903, 2904, 2913, 2922, 2923, 2924, 2925, 2926, 2928, 2933, 2934, 2943, 2959, 2960, 2963, 2964, 2965 (69), all in the Carnegie Museum and collected in the Departamento de Santa Cruz de la Sierra, Bolivia, by Dr. J. Steinbach.

Colouration.—Light to walnut brown above, with a dorsal series of triangular seal-brown light-edged markings, alternate with or sometimes opposite to those of the other side, and with a para-ventral series of seal-brown round markings, disposed in pairs, each pair corresponding to one triangular marking; head with two blackish transverse markings, one between the canthals and another between the supraoculars, and with two blackish longitudinal markings, usually connected with two other larger ones on the occiput and nape; yellowish-white beneath, powdered or irregularly spotted with brown at the base of the ventrals, especially on the sides.

Notes.—*B. newwiedii boliviana* may be distinguished from *B. atrox* (Linné, 1758), that also occurs at the Departamento de Santa Cruz de la Sierra, by the following characteristics:

	Second supralabial	Scale keel	Scale apical pits
<i>B. newwiedii boliviana</i>	separated from the lorus	long and low	large, double
<i>B. atrox</i>	forming the anterior border of the lorus	short and high	absent

Young specimens of *boliviana* seem to feed on frogs and the adults on rodents.

REFERENCE

- AMARAL, AFRANIO do: A general consideration of snake poisoning and observations on Neotropical pit-vipers. Contrib. Harvard Inst. Trop. Biol. and Med. II: 56-62. 1925.

3. SOME OBSERVATIONS ON THE RATTLESNAKES OF THE EXTREME SOUTHWEST

By L. M. KLAUBER

San Diego County, California, is the most southwesterly county in the United States. It lies in latitude 33 deg. N., and has an area of 4,200 square miles (about 70 miles east and west by 60 miles north and south). The population may be estimated at 175,000, nearly all of which is centered in the region immediately contiguous to San Diego Bay. Agricultural development is intensive along the coastal belt and likewise in certain fertile interior valleys; but the land susceptible of cultivation is but a small portion of the total area. As a result, wide expanses, including rocky and brush-covered foothills, forested mountains and barren desert, continue virtually undisturbed and the smaller animals, at least, with the exception of certain game birds and mammals, remain as they were prior to the settlement of the country. For this reason and, likewise, because the county has wide variations of climatic and topographical conditions within comparatively short distances, a study of the reptile fauna is of interest.

CALIFORNIA SPECIES OF RATTLESNAKES

So far as is known, rattlesnakes are the only venomous reptiles occurring in California; of the six species of rattlers found in the state, four are present in San Diego County. These are: The Pacific Rattlesnake (*Crotalus oreganus*), Red Diamond Rattlesnake (*Crotalus exsul*), Bleached Rattlesnake (*Crotalus mitchellii*) and Sidewinder (*Crotalus cerastes*). In a limited area in the desert slope valleys all four of these species occur together.

The other two species found in California are the Tiger Rattlesnake (*Crotalus tigris*) of the desert slope of the Sierras, and the Desert Diamond Rattlesnake (*Crotalus atrox atrox*) of the Colorado Desert.

The general ranges of these six species of snakes as now known are as follows:

PACIFIC RATTLESNAKE (*Crotalus oreganus*).—From British Columbia south through Washington, Oregon and California to the San Pedro Martir Mountains in Lower California; east to Idaho, Nevada, Utah and

Arizona. In California it ranges throughout the entire state except the Colorado Desert. It is less common in the Mojave Desert and the low-lying areas east of the ridge of the Sierras than elsewhere. It is also found on Santa Catalina and Los Coronados Islands.

RED DIAMOND RATTLESNAKE (*Crotalus exsul*).—The narrow belt in California and Lower California west of the desert to the coast, from the north line of Riverside County in California to north central Lower California, but excluding the coastal plains of Los Angeles and Orange Counties. It occurs also on Cerros and certain Gulf of California islands.

BLEACHED RATTLESNAKE (*Crotalus mitchellii*).—From central Arizona west to the base of the foothills on the western slope of the Coast Range in California, from northern Los Angeles County south through the entire peninsula of Lower California. It is also found on Santa Margarita Island and several islands in the Gulf.

SIDEWINDER (*Crotalus cerastes*).—The desert regions of southern California, northeastern Lower California, Arizona, southern Nevada and southwestern Utah. In California this snake ranges from central Inyo County south through the Mojave and Colorado Deserts and into northeastern Lower California at least as far south as the San Felipe Desert.

DESERT DIAMOND RATTLESNAKE (*Crotalus atrox atrox*).—From Texas west through New Mexico and Arizona to the Colorado Desert in California. Likewise northeastern Lower California and Tiburon Island. In California this snake has evidently not penetrated west or north of the Imperial and Coachella Valleys, in Imperial and Riverside Counties. It has not been recorded in the Mojave Desert. While it is quite possible that it may range into the Borega Valley in northeastern San Diego County, it has not yet been reported from this county.

TIGER RATTLESNAKE (*Crotalus tigris*).—The Desert Mountains of southern Arizona, southern Nevada and south central California. In California it has been reported from

a number of localities east of the Sierras in Inyo, Mono and northeastern Imperial Counties.

During the past four years a considerable collection of snakes has been recorded and identified for the Zoological Society of San Diego. Most of the specimens have been taken in San Diego County; these have established many new locality records which are here indicated by means of a map (Fig. 3, page 9). In addition there have been a few specimens from contiguous locations which we list below. Of particular interest are the *C. oreganus* specimens from the Mojave Desert, where previously it had been stated that this snake did not occur.

Crotalus oreganus

- Jim Grey, Goffs, Ibis, Needles
(San Bernardino Co., Calif.—Mojave Desert)
- Conejos (Ventura Co., Calif.)
- Aguila (Maricopa Co., Ariz.)
- Canyon Diablo (Coconino Co., Ariz.)
- Garcia, Redondo
(Northern Lower California)

Crotalus exsul

- Garcia, Redondo, Tecate, Ensenada
(Northern Lower California)

Crotalus mitchellii

- Garcia (Northern Lower California)

Crotalus cerastes

- Holtville, Calexico, Seeley, Dixieland,
Coyote Wells (Imperial Co., Calif.)
- Jim Grey, Mojave
(San Bernardino Co., Calif.)
- Yuma Mesa (Yuma Co., Ariz.)

Crotalus atrox atrox

- Dixieland, Seeley (Imperial Co., Calif.)
- Thermal (Riverside Co., Calif.)

Snake Bite Statistics

There are available for San Diego County no statistics on the frequency and importance of snake bite cases. It might be estimated that the number of cases in the county does not exceed eight per year. Even before the advent of antivenins, such cases rarely had a fatal termination. During the current year three cases were admitted to the County Hospital; none had a fatal outcome.

Of late years there has unquestionably been an increase in the number of cases. This is no doubt due to a larger population and a more

general use by numbers of motorists of the foothills and mountain districts for recreational purposes. There is no apparent indication that the snake population has either increased or decreased of late. In the area covered by the city of San Diego there has, of course, been a decrease, but elsewhere, even in the sections under intensive cultivation, there does not appear to be any notable change. Some ranchers may take exception to this view; but as their opinions are often contradictory, one stating that snakes have increased in a certain area while another is equally certain that they have decreased, it may be supposed that there has been no decided change. Some have noted an increase in the number of snakes observed on the roadside but this is unquestionably due to an increased daily mileage with the advent of better roads and more rapid transportation facilities. No change in the future need be expected unless it be caused by extensive brush fires or a great increase in rodents through agricultural development.

Snake Prevalence

It is difficult to secure data giving any indication of the relative prevalence of snakes in different areas, and I have available no dependable data which would indicate how San Diego County compares as a snake field with other sections of the country. Certainly I have never been successful in making catches comparable with some reported from certain other districts along the southern border.

In snake hunting there is apparently a strong element of chance. One may often fail to secure a single specimen on an ideal day at the peak of the season, and again a good catch may be obtained under what appear to be unfavorable circumstances. In this county six snakes may be considered a good day's catch for two persons hunting afoot during the best time in spring, this not including garter snakes hunted along a creek. This refers to persons with experience in snake hunting; the experienced collector can see and find snakes where the ordinary person would pass them by unnoticed.

Collecting snakes by driving is somewhat less successful from the standpoint of quality and number of specimens secured than hunt-

ing afoot. A successful day would produce one live snake for twenty-five miles of driving; the average is less than this, being hardly one snake per hundred miles, even during the months of April and May. There will be approximately four times as many dead snakes as live snakes found along the road, roughly one snake for every ten miles at the peak of the season.

There is some indication of an annual variation in the prevalence of snakes, probably due to fluctuations in the spring rains, but upon this no consistent data are as yet available. Throughout the State snakes were reported as unusually numerous in the spring and early summer of 1926, and this seems to be verified by our statistics for this county. The same condition was noted by experienced collectors in Lower California.

PROPORTION OF RATTLESNAKES

As to a comparison between the numbers of rattlesnakes and harmless snakes in this territory, somewhat more definite figures are available. Twenty-three species of snakes are known to occur in the county; of these four, or 17.4 per cent, are rattlers. Between November 10, 1922, and November 10, 1926, 2,454 snakes were collected and identified for the San Diego Zoological Society; of these 580, or 23.6 per cent, were rattlesnakes. During the past three years I have driven 9,837 miles on the county roads (in and out of snake season) and on these trips have identified 56 live snakes and 227 which had been killed by autos. Of the former, 10.7 per cent and of the latter 15 per cent were rattlers, the average for all

roadside snakes being 14.1 per cent. During this period I have collected 78 specimens while afoot in brush, cactus or rocks; of these 28, or 35.9 per cent, were rattlers. Having in mind various conditions affecting these statistics, such as the fact that ranchers will catch rattlesnakes for collections but prefer to have harmless snakes remain on their land; that more motorists will deliberately kill rattlers than harmless snakes; and that in hunting snakes a rattler is probably less often passed by the collector without being discovered than is a harmless snake, it may be estimated that rattlesnakes constitute approximately 20 per cent of our snake population.

PREVALENCE OF SPECIES

The relative frequency of occurrence of our four species of rattlesnakes, as indicated by the Zoological Society collection, is shown in Table I. These figures are not fairly representative of the sidewinders. The desert areas in San Diego County where *C. cerastes* occurs are relatively inaccessible, and in these areas *C. cerastes* is the commonest species, with *C. mitchellii* next and the other two scarce, or entirely lacking.

Until this year *C. oreganus* led *C. exsul* in numbers taken, but in the spring of 1926 the latter seemed to be unusually plentiful, and the record was equalized. We are still of the opinion that *C. oreganus* is a slightly more plentiful, though less conspicuous, snake.

Table I (percentage column) indicates that rattlers come out somewhat earlier in the spring than the harmless snakes, and likewise that they are relatively more plentiful

TABLE I
SPECIMENS COLLECTED IN SAN DIEGO COUNTY FOR THE ZOOLOGICAL SOCIETY
NOVEMBER 10, 1922, TO NOVEMBER 10, 1926

Month	Pacific Rattlesnake (<i>C. oreganus</i>)	Red Diamond Rattlesnake (<i>C. exsul</i>)	Bleached Rattlesnake (<i>C. mitchellii</i>)	Sidewinder (<i>C. cerastes</i>)	Total Rattlesnakes	Harmless Snakes	Total All Species	Per Cent Rattlesnakes
January.....	1	2	..	..	3	13	16	19
February.....	5	10	1	..	16	50	66	24
March.....	32	35	4	..	71	143	214	33
April.....	35	54	3	..	92	213	305	30
May.....	58	51	19	..	128	546	674	19
June.....	30	37	12	2	81	384	465	17
July.....	40	16	9	..	65	280	345	19
August.....	26	21	3	..	50	83	133	38
September.....	13	15	3	..	31	86	117	26
October.....	19	18	..	..	37	46	83	45
November.....	1	2	..	1	4	18	22	18
December.....	2	..	..	..	2	12	14	14
Total.....	262	261	54	3	580	1,874	2,453	23.6

in the fall. There is apparent no decided difference in the several species of rattlers as to their prevalence in time. To date *C. exsul* has had a somewhat earlier and sharper spring peak than *C. oreganus*, which is contrary to what might be expected from the general character of their habitats throughout California. This is largely the effect of the 1926 collections as compared with those of 1923-25, which indicates that a longer record will be necessary before the effects of unusual seasons and especially assiduous collectors in certain districts will be eliminated.

ZONAL DISTRIBUTION

Table II, in connection with the distributional map, gives an indication of the ranges of these snakes in San Diego County. The map must not be interpreted as indicating frequency of occurrence; it is locational only. It contains all published records to which the writer has had access, as well as the records of the Zoological Society of San Diego and the San Diego Society of Natural History. The table refers to the Zoological Society collection only. Specimens are credited to the towns nearest the actual points of collection.

It is not contended that the table gives an entirely accurate picture of the frequency of occurrence. There are certain conditions which render the data only approximate. Many specimens are found near to zone borders and must be arbitrarily allocated to one or the other district. Again, zones have decidedly different total areas and it would naturally be supposed that with an equal number of snakes per unit area the larger areas would tend to produce the greater number of specimens. Accessibility to collectors is of importance, and in this the mountain and desert zones suffer unduly.

TABLE II
ZONAL DISTRIBUTION OF RATTLESNAKES IN
ZOOLOGICAL SOCIETY COLLECTION
NOVEMBER 10, 1922, TO NOVEMBER 10, 1926

	Pacific Rattle- snake (<i>C. ore- ganus</i>)	Red Diamond Rattle- snake (<i>C. exsul</i>)	Bleached Rattle- snake (<i>C. mil- chellii</i>)	Side- winder (<i>C. cer- astes</i>)	Total
Coast (Upper Sonoran).....	118	129	..	..	247
Inland Valleys and Mesas (Lower Sono- ran).....	46	55	9	..	110
Foothills (Upper Sonoran).....	53	61	24	..	138
Mountain (Tran- sition).....	10	1	3	..	14
Desert Foothills (Upper to Lower Sono- ran).....	19	13	18	2	52
Desert (Lower Sonoran).....	..	..	..	1	1
Uncertain.....	16	2	..	..	18
Total.....	262	261	54	3	580

Certain general conclusions as to habitats are as follows: The Pacific and Red Diamond rattlesnakes are equally at home in the coast, inland valleys, and foothill areas. But in the mountains, particularly in the Transition areas above 4,000 feet, the Pacific rattler is definitely more at home than the Red Diamond.

Neglecting as uncertain (as to locality) a specimen of the Bleached rattler in the U. S. National Museum, we note the western limit of this snake to be fairly well defined by a line drawn from Valley Center to Dehesa. Although we have had several specimens from the inland valleys zone, all have come from the foothill edge, and elsewhere in this zone the snake must be relatively rare. It is strange that a snake so accustomed to Lower Sonoran conditions east of the mountains and

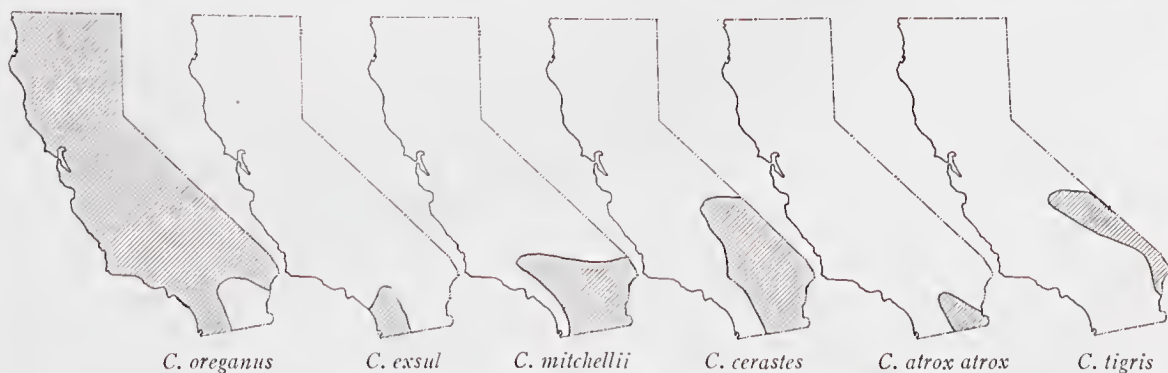


FIG. 4.—Approximate known ranges of the Rattlesnakes of California.

one which in fact was long considered a typical Lower Sonoran species, should stop on the edge of this zone west of the mountains. The transition records are of interest. This snake has proved to be somewhat more plentiful than a study of the literature led us to expect when we began collecting. It cannot be considered a rare species.

East of the mountains our data are much less complete. Only in the southeastern corner of the county, in the area between Hipass and Mountain Spring, is there a well-traveled highway. Here *C. exsul*, *C. oreganus* and *C. mitchellii* are almost equal in numbers; this is a decided relative gain for *C. mitchellii*, compared to the western slope. Collecting trips elsewhere in the desert districts have been few. In general, we have indications that *C. oreganus* and *C. exsul* become scarce or absent as we proceed eastward, encountering first isolated desert valleys and finally the floor of the desert itself. Here *C. mitchellii* holds its own, but *C. cerastes* becomes definitely the commonest species.

Those found moving are usually more ready to fight than those which are coiled and resting. Some individuals will not even attempt a defensive fight and may be roughly handled without showing the least disposition to bite, or even rattle. *C. mitchellii* ordinarily exhibits a somewhat quicker readiness to fight than the others. *C. exsul* is very definitely the least offensive, and in this differs considerably from its nearest relative, *C. atrox atrox*. On only two occasions have I observed specimens of *C. exsul* to give notice of their presence by rattling before being disturbed; in both cases, in fact, they would have been passed by had they not rattled. There is, of course, no way of estimating how many hundreds of snakes I have passed closely in the field which have saved themselves by making no sound. In two cases recently I have found rattlers by hearing the characteristic "click" which they make when drawing themselves into a defensive coil, but without rattling. One of these was a specimen of *C. exsul*, the other, *C. mitchellii*.

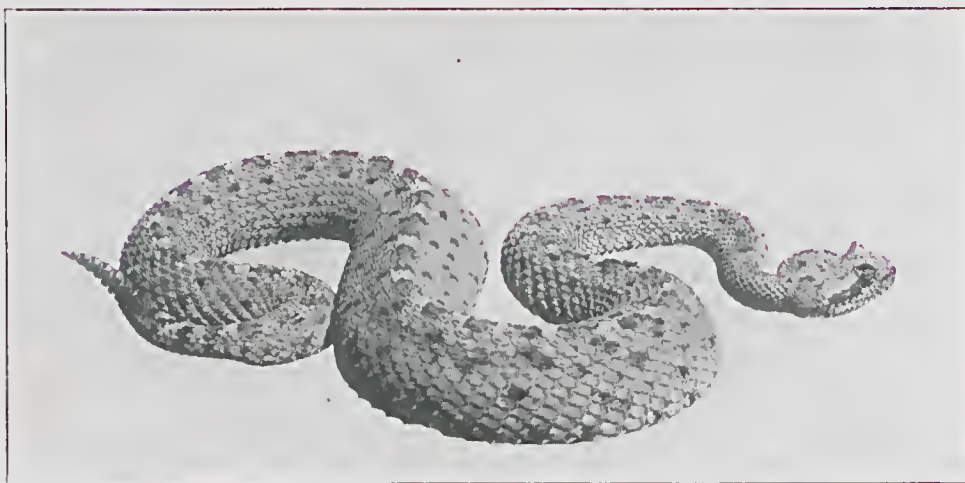


FIG. 5.—
Adult
Sidewinder
(*Crotalus
cerastes*).

TEMPERAMENT OF THE RATTLESNAKE

It is probable that there is as much difference in temperament among the individuals of any one species of rattlesnake as found in this area, as there is an average difference between the several species. All four local species appear to be relatively inoffensive. Invariably they attempt to escape, and I have yet to experience in the field an instance of a snake adopting an offensive attitude. While some individuals will put up a fight when cornered, their actions are apparently entirely defensive.

THE COIL AND STRIKE

Those unfamiliar with rattlesnakes in the field confuse the tight circular resting coil in which they are usually found (often popularly reported as "coiled ready to strike") with the true fighting posture. As a matter of fact, a rattler found coiled and previously undisturbed will change its posture entirely when assuming its typical fighting attitude. From the resting coil it can strike but a short distance without twisting the body laterally, and thus losing its aim. Although it may be

assumed that a suddenly frightened snake might make a short strike directly from the resting coil, I have never seen it done.

But the fighting coil is quite a different thing, and when in this posture there is no mistaking the snake's intentions. The head and anterior third of the body are raised clear of the ground in an angular loop, with the neck higher than the head, as one would poise a lance. The rest of the body, as an anchor, takes a loose circular or S-shaped form on the ground. The tongue is protruded to the fullest extent and is moved periodically from a pendant to a vertical position. The body is flattened posteriorly and the breath is alternately expelled and inhaled in a violent hiss. The rattle is usually but not always sounded continuously. From this position the snake can strike directly forward for at least one-half, and if violently angered or frightened, probably for three-quarters of its length, the strike consisting in straightening the body into a forward lunge. The fighting posture not only permits striking to the maximum distance, but has the additional advantage that while facing the enemy the snake can (and often does) retreat to either side or backwards to some bush or rockpile in which it hopes to find refuge. It is probably this retreat while facing an enemy in a fighting pose that forms the basis of the stories of rattlesnakes chasing persons.

Never having seen a snake strike its prey in the field I can give no data on the accuracy of the strike; in captivity, it is often poor. An angered snake striking at an enemy in the field occasionally judges distance badly and strikes at an object many feet beyond its reach; however, this may be done for effect. The strike of a thoroughly angered snake in warm weather is so rapid that the motion of the head cannot be followed with the eye; only the white of the open mouth can be seen at the end of the stroke. This speed, however, is by no means invariable. The return stroke is generally slower and can usually be observed. I have never seen a snake begin a strike, or in fact threaten an enemy, with open mouth as sometimes pictured. Venom is sometimes sprayed for a considerable distance at the end of the stroke when the object struck at is missed; this is probably due to the violence of the snake's anger rather than to any intention.

A large snake in the fighting position has its head raised approximately eight to ten inches from the ground and, as it strikes on the level or slightly downward, puttees or thick boots are an excellent protection. It would seem that the principal hazard from such snakes as our rattlesnakes to those with legs improperly protected, would follow stepping on a snake outstretched, in which case it would probably whirl and bite instantly; or in passing close to a snake already in the fighting pose (but without the rattle sounding, as is sometimes the case) which has been disturbed by some one ahead on the trail.

RATTLESNAKE ENEMIES

Aside from man, the principal enemies of the rattlesnakes in this county are birds and other snakes. Eagles, hawks and owls are sometimes seen carrying rattlers or other snakes in their talons. Of their ophidian enemies, those which have been definitely observed to eat rattlesnakes are Boyle's King Snake (*Lampropeltis getulus boylii*), the California King Snake (*Lampropeltis californica californica*), the Red Racer (*Masticophis flagellum frenatus*), and the California Striped Racer (*Masticophis lateralis*). It is probable that the ability of these snakes, particularly the two king snakes, to conquer rattlesnakes, is considerably exaggerated in the public mind. Nevertheless, there is no question but that they do eat young and partly grown rattlers. It is doubtful whether in their search for prey they distinguish between rattlesnakes and harmless species.

Certain experimental work on rattlesnakes in captivity would seem to indicate that the king snake is recognized as an enemy. Small rattlesnakes placed in cages with king snakes have been observed to act in a peculiar manner. Being cornered, the head is placed on the ground, the body is raised in a vertical loop against the obstruction, which prevents escape. This naturally hinders the king snake in securing a hold on the head. This offers an interesting field for future observation.

The Road-runner (*Geococcyx californianus*) is an enemy of small rattlesnakes, as of most other snakes and lizards. His behavior in the face of a large rattler is probably greatly exaggerated in the public mind. The story of

the cactus corral which the road-runner is supposed to build around the rattler, thus causing him to commit suicide by biting himself, is current in this territory, but is rendered doubly doubtful, as the rattler is immune to his own bite and appears to be able to crawl through or over the most impenetrable cactus. Cactus is, in fact, a favorite hunting ground and refuge. Snakes are sometimes found with many cactus spines in the skin, seemingly without causing serious harm.

RATTLESNAKE HABITATS—SOME FIELD OBSERVATIONS

While, as has been indicated, rattlesnakes are fairly evenly distributed from the Coast to the mountains, I have always preferred hunting in the foothill regions at an elevation of between 2,500 and 3,500 feet. Here in the early spring the rattlers may be found basking in the sun among the granite ledges where food is plentiful and refuge easy of access. Occasionally, in fact, a snake will be found in front of a small crevice or hollow under a boulder in which it takes refuge so quickly that it would appear a location selected by design. This was noted recently in two cases of *C. mitchellii*. The snakes are sometimes in pairs and trios, but anything approaching a snake den I have never observed in this country, although reports of them are frequent.

With the coming of the summer and the passing of the mating season and the spring hunger, snakes become scarcer and are more frequently found in shady retreats or in hollows under flat stones. On one occasion near La Posta (July 5, 1925) I found three well-grown Pacific rattlesnakes under a single flat stone which completely concealed them. Similarly, I have observed a small Pacific rattler under an oak log and a Red Diamond rattlesnake under a granite flake. There is every evidence that rattlesnakes become nocturnal in summer in the heated areas distant from the Coast; this is certainly true on the desert.

Louis P. Faldborg, of Chula Vista, has brought in many fine specimens of rattlesnakes, particularly *C. exsul*. He prefers for his collecting field the Coast and mesa areas at a somewhat lower altitude than my favorite localities. He thus describes his field experiences:

"Conditions under which rattlesnakes are found vary somewhat with altitude and season of the year. On the west and south slopes of Soledad, San Miguel and Black Mountains, Red Diamond rattlesnakes are readily found during the fall, winter and early spring months, and especially on warm days preceding rains. These snakes are generally found in a coiled position, in sheltered caves of rock, at the mouth of a rock crevice or hole, just far enough out to allow the sun to strike them. I have reason to believe they crawl out during the day and back again at night, for on several occasions I have found them in the act of coming out about noontime. However, these snakes show very little activity and rarely make any resistance, except a slight inclination to escape when I capture them. Sometimes they strike once or twice at my stick and may be rattle a little. I couldn't exactly say that they are found bunched together or in pairs, though many times I have found them within fifty feet of each other in the same cave.

"As spring advances and the hot dry days of summer come, the snakes on these slopes become far less numerous. If found at all they are in a stretched-out position or crawling through the brush. Then they are of a different nature. I have known them to puff, hiss, rattle and strike at my stick with the rapidity of a machine gun, meanwhile backing toward a bush or some other avenue of escape.

"On the lower lands, between the foothills and the ocean, these Red Rattlers are rarely found during the winter months. However, beginning in February and during the spring months until June, they are readily found in the warm, sunshiny ravines, with slopes facing the south that have an abundance of cacti, sumac and brush and that are protected from the west winds.

"On these lower levels, between foothills and ocean, beginning in June and during the summer and early fall months, a change in the activity of these Red Rattlers is easily noticed. They are then not alone confined to any place or condition as in the springtime. As a matter of fact, they are apt to be found any place. They seem then to be possessed of a roving nature. I have found them crawling in the open and the brush as well, at all times of the day from daylight till dark. I have also found them coiled and resting at all times of the day. Have found many instances that would make me believe that they travel a good deal at night time during the summer months. At this time of the year I rarely find them in pairs or close together.

"The cactus is a favorite place for finding them and I do not remember ever finding a snake on these lower levels that was not in a cactus clump, or within a few feet of one.

However, this applies to the springtime only. These snakes seem to be found more in pairs at this time of the year, either coiled up together or one coiled and the other outstretched within a foot or so of each other.

"Though the Red Rattler is generally found on the ground, I have on two occasions found them in trees. For instance, a year ago I found a small female lying stretched out full length, fully six feet above the ground on the limb of a sumac bush. Another time I found a female under similar conditions in a tree, while on the ground underneath her lay a large male outstretched. Then several times I have found both sexes on the top branches of cactus five feet high, some coiled and some stretched out.

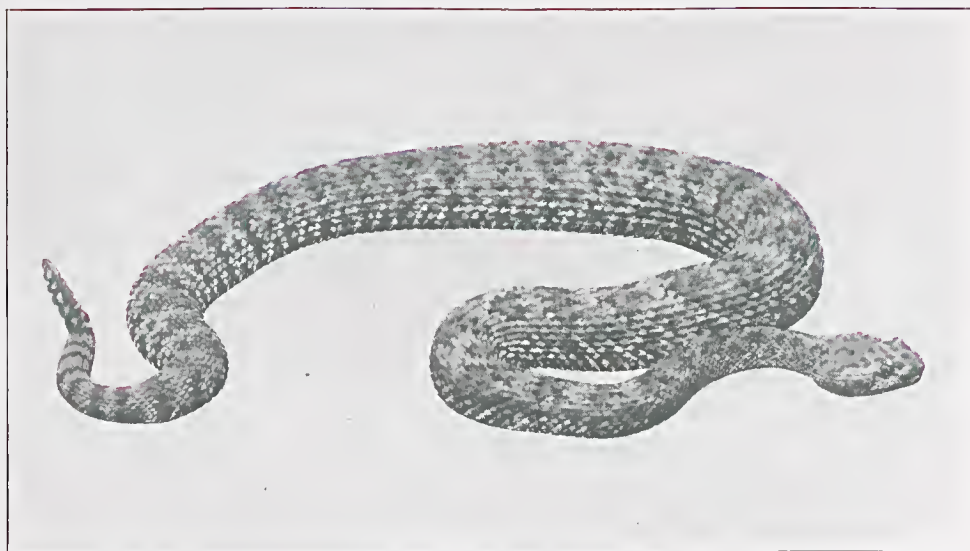
"I have never found a snake den. The most snakes I have found together was on two occasions, once close to La Jolla, and once

"Regarding the fighting qualities of rattlers, I have never known them to take the offensive side of a fight. Their fighting and striking is merely for their own defense. It is only after they are molested that they show activity and then their first inclination is to escape. When not disturbed they seem indifferent to our presence.

"It is the rattlers found traveling or in outstretched positions during the summer that seem the most vicious. Those are the ones that can put up an interesting scrap to elude capture; far more so than when found coiled."

In the mountain areas the rattlers come out somewhat later. Here the Pacific Rattler is particularly at home. I have taken a specimen under the wooden observation platform at Cuyamaca Peak, elevation 6,515 ft., which

FIG. 6.—
Young Adult
Bleached
Rattlesnake
(*Crotalus
mitchellii*).



in Telegraph Canyon, when I found three each time, two coiled together and another coiled within a foot distant. On both occasions they were all lying in the open in the grass.

"In my opinion the sharp edges of rock and prickly pear cactus play an important part in the life of snakes. Seemingly just before shedding their skins they hunt up these sharp edges of rock and stickers, crawl on them, either to relieve an itchy sensation or to find something to hold the old skin so they can more readily crawl out of it. My reason for believing this is that so many times when I find them with ragged skins ready to shed they seem to be hunting for something upon which to fasten the old skin. And again, the old skins are generally fastened between two rocks or on cacti stickers. I have watched rattlesnakes shed their skins but have never noticed anything about their being blind at this time.

is the highest point in San Diego County; they are known to attain considerably greater altitudes elsewhere in California.

On the desert mountain slopes the trees and dense brush of the western slopes give way to masses of bare rock and scattered cactus and thorny shrubs. Here in the early spring *C. mitchellii* will be found and below in the sandy and stony desert wastes, *C. cerastes*. The latter must be hunted in the early spring and fall; in the summer it seems entirely nocturnal. A rancher in the Borega Valley stated that Sidewinders were particularly plentiful in April and September. He thought they were especially evident under bushes after the infrequent showers.

Crotalus cerastes is said by some to be par-

ticularly vicious. Not having had frequent opportunity to observe it in its natural habitat, I cannot state as to this. In captivity it shows no essential difference from the other rattlers.

The sidewise, looping motion which gives it its name is accentuated when it is excited or in a hurry. At such times the middle section of the body is thrown out in a loop; this section is then anchored and the balance of the body is drawn laterally in a line perpendicular to the direction in which the snake is facing. The action is so continuous that the snake has the appearance of flowing sidewise over the ground. The snake may move with equal facility either to right or left.

When proceeding somewhat more slowly the snake draws the central portion of the body forward in a sharp loop, the apex of the loop often being well in advance of the head. The head is then advanced and the snake thus proceeds in the direction in which it is facing rather than laterally. When progressing very slowly, a more normal snake-like motion is assumed.

It is doubtful whether any snake, even a sidewinder, can stand the terrific heat of the desert sun in summer. On the whole the love of snakes for warmth is exaggerated in the public mind. After the winter hibernation snakes take advantage of the first warm spring days to bask in the sunlight, but the heat of a summer day, except along the temperate coast, is not to their liking. The temperature of the ground is too great for comfort. Thus, as is verified by our statistics, the snake season in this territory is not July and August, as popularly supposed, but April, May and early June. On the desert these conditions are accentuated. Our willing amateur collectors must be cautioned continually to keep their catches out of the sun; many good specimens have been lost through failure to observe this rule.

The Pacific rattlesnake appears to have a more roving disposition than the others. This is particularly true of the younger specimens. Of the rattlers noted, dead or alive, on the highway during the past three years, 60 per cent were *C. oreganus*, 30 per cent *C. exsul* and 10 per cent *C. mitchellii*, while the corresponding figures for the Zoölogical Society collection were 45, 45 and 10 per cent. Twenty per cent of all rattlers found on the roadside were *C. oreganus* less than one year old, but no young *C. exsul* was found.

As noted by Mr. Faldborg, rattlers take to the brush occasionally and travel above ground, for what purpose I cannot say, unless it be in pursuit of prey. This year I found a specimen of *C. exsul* at a height of approximately eighteen inches above the ground, which attempted to escape by continuing at this height through the brush.

Our local rattlesnakes mate in the spring and the young are born alive in the autumn. *C. exsul* has been observed mating April 13, 1924, and April 20, 1924. One specimen of *C. oreganus* gave birth to young Sept. 3, 1925.

THE RATTLE

In rocky and brushy territory complete sets of rattles, that is, containing the original button, are infrequent above six or seven. Thus, an adult specimen never has a complete set, but always shows that an indeterminate number of rings have been lost by breakage. The number of rattles present in an adult specimen is generally from six to ten, although as many as fourteen have been observed recently. Some of the very long sets seen in snake shows are faked; this can be done by matching and joining sets so that the deception is not easily detected. Species inhabiting sandy, desert areas, such as *C. cerastes*, *C. atrox atrox* and the desert specimens of *C. mitchellii*, not infrequently have long strings, sometimes tapering to the original button, for here the rattles are not so readily broken.

It is now becoming generally well known that the number of rattles is no indication of age; first, because of loss by breakage, and second, because the number of rattles per year, coincident with the number of skin changes, is variable, probably running from two to five.

The use of the rattle as a warning is dependent on the disposition of the snake, as above noted. While the warning is usually sounded when the snake is disturbed, this is not invariable; occasionally one will strike without rattling while others, even under severe provocation, will neither strike nor rattle.

FOOD

Rattlesnakes are known to subsist largely on small mammals, such as rabbits, ground squirrels, rats and mice. Often when they have been captured they disgorge food re-

cently eaten; we have had specimens which disgorged rabbits, rats and mice. We have had no experiences with rattlers which have eaten snakes or lizards, although it is known that they occasionally do so. It is difficult to believe that small snakes, particularly young Sidewinders, can find mammals small enough for subsistence.

In captivity none of our rattlers feed readily; however, there appears to be no essential difference in our local species, as an occasional individual of any species may take food. Forced feeding is not often resorted to as it is somewhat dangerous and not overly successful, the necessary handling being hard on the snake.

Altogether, rattlesnakes are not especially satisfactory exhibits, although always of great interest to the public, particularly if they will rattle when approached. It is surprising how many persons in this western country have never seen a live rattler in its native habitat nor even heard the rattle. Our local specimens maintain a fighting disposition for a few days only; after that they become lethargic. A snake collector in Los Angeles who furnishes snakes needed in filming motion picture scenes informed me that *C. exsul* quickly becomes so lethargic in captivity that it cannot be made to act, i. e., to assume a fighting posture, and it was, therefore, necessary to secure specimens of *C. atrox atrox* from Texas for this purpose.

DISTINGUISHING RATTLESNAKES—COLORS AND PATTERNS

With an occasional individual exception, the rattlesnakes of this territory may readily be distinguished from each other by color and

markings alone. In a few young specimens, particularly from the desert foothill areas, these conditions are not always so pronounced, but in any case certain other characteristics render identification simple and definite. A non-technical differentiation of adult specimens may be made on the following basis: (This is applicable primarily to the color variations found in this county.)

Species	Adult size	General coloration	Conspicuous dorsal markings	Horns over eyes
Pacific Rattlesnake (<i>C. oreganus</i>).....	medium	gray, black	diamonds or hexagons	absent
Red Diamond Rattlesnake (<i>C. exsul</i>)	large	red, brown	diamonds	absent
Bleached Rattlesnake (<i>C. milchellii</i>)	medium	buff, salmon, brown, gray	indefinite bands, imperfect hexagons	moderate
Sidewinder (<i>C. cerastes</i>).....	small	straw	brown rectangles or hexagons	prominent

In coloration, *C. oreganus* (Fig. 7) shows much variation, although not to the extent in this restricted territory that it does throughout its range. Locally, the largest specimens are quite generally black, with distinct dorsal diamonds about ten scales wide, bordered by single rows of grayish or buff scales. Each diamond usually has a separate border, i. e., where contiguous the borders are two scales wide. Occasionally the diamonds are truncated into hexagons. Posteriorly, the diamonds degenerate into bands or rings. On the sides there are second and third series of diamonds, more distinct posteriorly. The tail



FIG. 7.—Young Adult Pacific Rattlesnake (*Crotalus oreganus*).

is sometimes black, sometimes banded with gray. From a point below and in front of the eye to the angle of the mouth there is a broad, light stripe; above the eye is a thinner light stripe parallel to the first. The under surfaces are mottled black or gray with yellow or white.

Medium size specimens apparently show the greatest color variations. They tend to be lighter than the fully adult specimens and often show a gray or brown tone. Occasionally in individuals which have but recently changed their skins there is a distinct pink or green tinge, and some are in fact so green in color that they are thought to be green rattlesnakes by the uninitiated, although showing no resemblance, except the greenish tinge, to *C. lepidus*, the true Green Rattlesnake. It may be noted at this point that some specimens from the Mojave Desert were quite yellow; others from Arizona were yellow green virtually without dark markings.

In moderate-sized specimens, as in the young, the borders of the diamonds are generally wider and more distinct; the diamonds thus constitute less of the total area causing the lighter general tone.

The young specimens are characterized by bright head stripes which are usually as follows: there is a light stripe across the head between supraoculars and a second somewhat narrower between nostrils. On each side of the head the former stripe continues to the temporal region, the latter parallel thereto, passes in front of the eye to the angle of the mouth. Sometimes there is a thin light stripe at the median line perpendicular to the two stripes across the head. The rostral and the lower edges of the supralabials are tinged with light. The infralabials are dark. These stripes are so distinct that the head of the young *C. oreganus* has a brightly marked appearance, while *C. exsul* on the contrary has a head almost unicolor. Only the side stripe forward of the eye is evident in *C. exsul*; this is less prominent than in *C. oreganus*, and approaches the mouth at a steeper angle, reaching it below the eye, whence it runs back along the supralabials. The stripe beginning in the postocular area is but faintly evident. In the young of *C. oreganus* the tip of the tail just ahead of the rattle is yellow; in *C. exsul* it is striped black and white. These

differences are pointed out in some detail as the distinguishing of young specimens is more difficult than adults; the colorations tend to diverge with age and, as the snakes occur in this district, the adult ground colors are so different that there is no difficulty in classification.

The Red Diamond Rattlesnake (Fig. 8) is a handsome snake and throughout this territory at least is fairly constant in coloration. The adult color is red-brown, darker anteriorly, with a series of whitish diamonds on the back, most prominent in the center of the body, less distinct toward the head and tail. The tail itself is gray-white, crossed by four or five black rings, and in sharp contrast to the rest of the body. In the adult snake, variations in ground color from the typical are from a buff to a deep red-brown. The general reddish tinge strongly contrasting with the striped tail is, however, always evident. The diamonds are occasionally partly obsolete and are of course not so definite in specimens just before shedding. The diamonds are usually formed of a single row of whitish or yellowish scales, the outlines being less distinct along the sides than along the dorsal line. The ground color tends to be darker along the inner edge of the diamond, but no distinct black diamond is noted within the light diamond, as is so often the case with *C. atrox atrox*. The color below is straw yellow, except that the black rings show faintly across the tail. The head above is uniformly red-brown. There is a light stripe across the side of the head from the front of the eye to the center of the mouth and another back of the eye; both, however, are relatively indistinct.

C. exsul is black just before birth, although the coloration is of such a character that all except the tail stripes fade quickly in alcohol. No specimens have been seen immediately after birth, but young specimens, which probably did not exceed a few weeks old, already exhibited the characteristic reddish tinge. However, the general coloration is distinctly darker in young than in adult specimens. This change in coloration appears to continue throughout life, so that the largest specimens are usually the lightest in color.

Specimens of *Crotalus exsul* may be readily differentiated from the other rattlesnakes in this district by the color combined with the

markings. While some specimens of *Crotalus mitchellii* are quite red, the coloration in general is lighter and more vermillion in tone; in addition, *C. mitchellii* has bands rather than diamonds and the markings are less distinct and regular.

Some specimens of *C. atrox atrox* from the Imperial Valley have a decided pinkish tinge, differing from the general gray coloration of the Arizona and Texas specimens. However, this is not true of all California specimens.

As to a more technical differentiation, *C. exsul* is characterized in this district at least by the almost universal division of the first infralabials. I have yet to see a specimen with both infralabials undivided, and from my observations I would say that a single undivided infralabial occurs in about one specimen in twenty-five. This characteristic is, I believe, shown occasionally by *C. atrox*

Cope's Plate XXII in Vol. V of the 100th Meridian Report is hardly an exaggeration.

The most usual coloration is gray-brown, the salmon color being next. Smaller specimens from the desert foothills are usually buff or pinkish-buff. Some are straw colored. I have never seen one from this area, nor from Imperial County, that might be called white by any stretch of the imagination, the lightest *C. mitchellii* being somewhat the same tone as the darkest *C. cerastes*.

The dorsal blotches are usually not definitely outlined—they vary from hexagons through bands to indented rectangles like hour-glasses. A second and third series of blotches alternate with the main series along the sides. The ground color is finely punctuated with small dots, more intense in the blotches, less so between, particularly along the dorsal line. The head is mottled; the

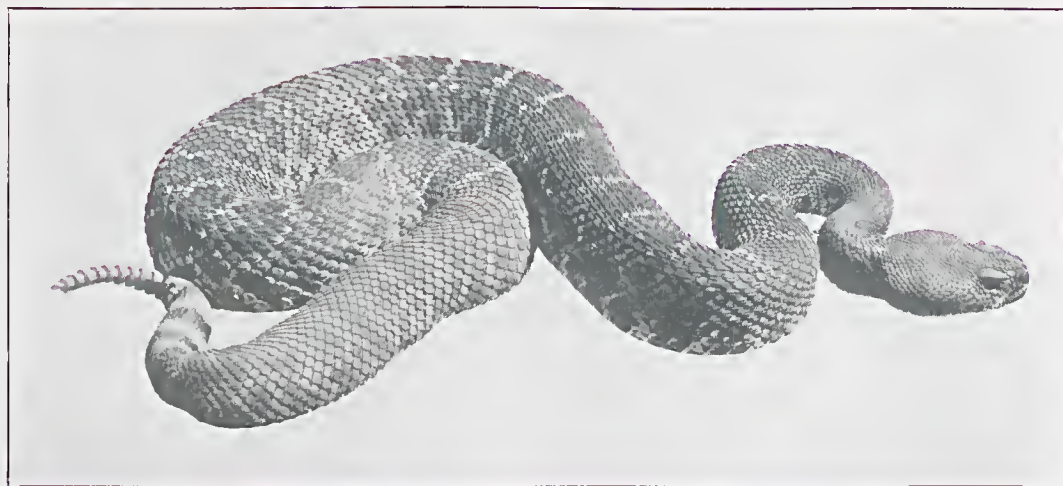


FIG. 8.—Adult Red Diamond Rattlesnake (*Crotalus exsul*).

atrox. A specimen of *C. atrox atrox* from Thermal, Riverside County, California, had infralabials which, while undivided, were distinctly creased.

The coloration of *C. exsul* would not appear to be particularly useful from the standpoint of protection. While there are large areas in San Diego County in which the soil is reddish, there are others in which it is gray, and in these the red diamond rattlers are equally prevalent. The color is conspicuous against the green of cactus or the gray of granite boulders. I have espied specimens lying without movement on granite boulders at a distance of not less than one hundred feet, and in the same situation *C. oreganus* would probably have been virtually invisible.

C. mitchellii (Fig. 6) exhibits a wide variety of coloration, from buff and pink to gray, brown, red and black-and-white. The red specimens are occasionally very brilliant, and

supraoculars often tipped with a prominent light spot. The lower surfaces are straw, often spotted with white.

As to scutellation, these snakes may be distinguished from any of the others in this territory, or in fact from any rattlesnakes, by the small scales between the rostral and the anterior nasal. These are always present in the specimens that I have seen, either as a single row or an irregular group. The supraoculars are prominent, and raised at the outer edges, more so than in *C. exsul* and *C. oreganus*, but without showing the exaggerated horns of the sidewinder.

The Sidewinder, *C. cerastes* (Fig. 5), is rather more constant in coloration than most species of rattlesnakes. The description of a typical live adult specimen is as follows: The ground color is dark straw which is given a darker tinge by a multiplicity of dark brown dots. Along the mid-dorsal line there is a series of

dark brown hexagons about six scales wide and two to two-and-a-half scales long, longitudinally. The edges of these are somewhat darker. Along the dorsal line the dots are partly omitted; thus, the dorsal spaces between the hexagons are lighter than the adjacent surfaces. On the sides, alternating with the main dorsal blotches and with each other, there is a second, third and fourth series of blotches all smaller and, in general, darker, than the main series. The last touches the edge of the ventral scales. The under surface is clear straw to white. The under surface of the head is unspotted. There are two round brown spots on the back of the head; also a distinct brown dash from the eye to the angle of the mouth. The tail is crossed by black bars.

In some specimens the brown hexagons which constitute the most conspicuous marking are divided by a light dorsal line into two distinct rows. In some specimens they are quite rectangular. Occasionally specimens from the foothill region are distinctly darker than those from the floor of the desert.

Although *C. cerastes* may be readily distinguished from the other rattlesnakes in this vicinity by its coloration, even more pronounced are the prominent horns over the eyes which readily differentiate it from the lightest colored young *C. mitchellii* of the desert. Exaggerated supraoculars, although present in *C. mitchellii*, are not nearly so pronounced as in *C. cerastes*.

As to the horns, they may obviously be accounted for as being useful as partial shade for the eyes from the intense glare and heat of the desert sun. Likewise, it may be suggested that they serve as sand shields. The sidewinder is not infrequently found half, or almost entirely, buried in the sand. Whether it buries itself deliberately or only lies quietly until covered by the drifting sand, I do not know, but in such cases the head is usually partly uncovered. The horns over the eyes serve to form a small cliff in the drifting sand, at least on the lee side, and it might be thought that this would be of considerable service to the animal in watching for food.

THE SIZE OF RATTLESNAKES

Crotalus exsul is the largest rattlesnake found in this area. Specimens slightly exceeding six feet in length are well authenticated. While others up to eight feet have been reported I have been unable to verify them. Such reports are not infrequently based on stretched skins, and as is well known, a skin may be stretched to nearly 150 per cent of the normal length of the snake. It is not impossible, however, that an occasional snake rivals in size *C. atrox atrox* in Texas. The average of what might be called large speci-

mens would probably be close to five feet. Such a specimen weighs approximately three pounds. The young at birth are about one foot in length (average of nine specimens in one unborn brood was 12.9 inches).

Crotalus oreganus is a distinctly smaller snake than *C. exsul*; while an occasional specimen closely approaches five feet in length, the majority of the adult specimens taken are under four.

An adult *C. mitchellii* will approximate four feet in length.

The Sidewinder is the smallest of our rattlesnakes. Most of the specimens which we have had from the Imperial Valley have been about eighteen inches in length. Occasionally somewhat over two and a half feet is attained.

COMMON NAMES

Consistent popular names are important in permitting information to be secured on field observations from amateur naturalists, ranchers and others who come in contact with these animals and are reasonably accurate observers. It would be highly desirable to standardize these names more than is at present the case, as most persons do not take readily to the use of technical names.

The common names of *C. oreganus* in this territory are Pacific Rattlesnake, Black Rattlesnake, Diamond-back Rattlesnake and Black-diamond Rattlesnake. Pacific Rattlesnake is unquestionably the most logical popular name. Most persons readily distinguish this snake from the other rattlers of this district, with the possible exception of the gray individuals of *C. mitchellii*.

Crotalus exsul is generally known as the Red Diamond Rattlesnake, or Red Rattlesnake. Most persons, such as ranchers who are in any way familiar with rattlesnakes, readily distinguish this snake from *C. oreganus*. On account of its probable relationship with *C. atrox atrox*, Red Diamond Rattlesnake is perhaps the more fitting popular name, particularly as many specimens of *C. mitchellii* might also be termed red rattlesnakes. I have lately seen in a snake show a live rattlesnake which was said to have come from New Mexico, which was quite as red as any *C. exsul*, although the pattern was different. It was probably *C. confluentus*.

I find that few persons who have not made more or less of a study of snakes are able to distinguish *C. mitchellii*. The gray specimens are confused with *C. oreganus* and the red with *C. exsul*. The smaller, lighter specimens from desert areas are sometimes confused with *C. cerastes*, this notwithstanding the fact that after the most superficial acquaintance with snakes the differences are quite obvious. For the reason that *C. mitchellii* is so rarely distinguished, it has no definite common name,

although referred to in various texts as the Bleached Rattlesnake (Van Denburgh), Pallid Rattlesnake (Grinnell and Camp) and the White Rattlesnake (Stejneger—Ditmars). As far as the specimens found in this territory are concerned, these names are not well suited, as the snakes are certainly not white and are in fact on the average neither bleached nor pallid, being on the contrary frequently brilliantly colored, although not distinctly patterned. It might be best if the public could be educated to refer to this snake as Mitchell's Rattlesnake.

The Sidewinder is popularly known by this name in this territory. Seldom is it referred to by its alternative popular name of Horned Rattlesnake.

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FIG. 9.—Adult Specimens of the Four Species of Rattlesnakes Found in San Diego County, California. Upper Left—*C. exsul*. Upper Right—*C. mitchellii*. Lower Left—*C. cerastes*. Lower Right—*C. oreganus*.

4. STUDIES OF NEOTROPICAL OPHIDIA

V. NOTES ON *BOTHIROPS LANSBERGII* AND *B. BRACHYSTOMA*

By AFRANIO DO AMARAL

The pit-vipers that in South America and throughout Central America are usually called "Chatilla" or "Tamagú" must be identified with *Bothrops lansbergii* (Schlegel, 1841) and *B. brachystoma* (Cope, 1859).

As a matter of fact, much confusion has prevailed as to the distinctive characteristics to be assigned to these two species and a few well-known herpetologists as, for instance, Albert Günther, of the British Museum, and Fritz Müller, of the Basel Museum, have even identified specimens of *B. brachystoma* with *B. lansbergii*. However, based on the examination of 14 specimens, Boulenger, in his Catalogue of the Snakes in the British Museum III: 546-547, 1896, was able to set forth their differential characteristics as follows:

	Snout	Rostral	Sc.	V.
<i>B. lansbergii</i> (6 specimens)	turned up at the end	$1\frac{1}{3}$ to $1\frac{1}{2}$ times as deep as broad	25-27	153-159
<i>B. brachystoma</i> (8 specimens)	much produced above	$1\frac{1}{2}$ to 2 times as deep as broad	23 (25)	132-150

Having examined a much larger series of specimens, I have found that neither the number of scale rows nor the number of ventrals could be very safely used as distinctive characteristics of *B. lansbergii* and *B. brachystoma* because they often overlap. The hemipenis formation cannot be used for that purpose either, because I have found that in both species it is as follows: divided; sulcus forked; calyces absent; spines present from below the bifurcation level of the sulcus to the top, lower spines longer, upper very small, sharp and numerous.

The remaining character, that is the shape of snout associated with the relative size of the rostral, is the only one that is really reliable, although specimens may sometimes not show it very clearly on account of injuries in their head or of poor preservation. It was, therefore, necessary that other points be found that could be used to distinguish *B. lansbergii* from *B. brachystoma*. With this view I examined a series of 30 specimens of

B. lansbergii and 28 of *B. brachystoma*, all of which were preserved in different North American collections as follows:

	<i>B. lansbergii</i>	<i>B. brachystoma</i>
Museum of Comparative Zoölogy.....	3	13
United States National Museum.....	11	13
Carnegie Museum.....	16	..
University of Michigan Museum.....	..	2

The specimens of *B. lansbergii* were collected in Venezuela, Colombia, Panama, Costa Rica, Salvador and Mexico. Those of the *B. brachystoma* were from the region of the Cayapas and Santiago Rivers, in Ecuador (6 specimens in the collection of the United States National Museum) and from Panama, Costa Rica, Nicaragua and Honduras.

As a result of that study I have come to the conclusion that the head of *B. brachystoma*, considered as a whole, is higher than that of *B. lansbergii*, and also that the following characteristics may be used in their differentiation in addition to those pointed out before:

	Sc. between supra-labials and lorulus	Sc. between subocular and supra-labials	Outside border of supra-ocular	Habitat
<i>B. lansbergii</i>	0-1 row	1-2 rows	low and sharp (edge-like)	cool to warm, dry, arid or semi-arid places
<i>B. brachystoma</i>	1-2 rows	2-3 rows	high and thick (surface-like)	warm and humid places

In conclusion, it is safe to state that *B. lansbergii* and *B. brachystoma* seem to have recently evolved from a common ancestral form: *brachystoma* appears to have become accustomed to living in warm and humid climates and *lansbergii*, under rather dry conditions.

Acknowledgment is extended to Dr. Thomas Barbour, of the Museum of Comparative Zoölogy, Dr. Leonhard Stejneger, of the United States National Museum, Dr. Alexander Ruthven, of the Museum of the University of Michigan, and Dr. Arthur W. Henn, of the Carnegie Museum, for permission to study the material of their respective collections.

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5. NOTES ON THE TEXAS RATTLESNAKES

By M. L. CRIMMINS

PREVALENCE OF POISONOUS SNAKES IN THE EL PASO AND SAN-ANTONIO DISTRICTS IN TEXAS

In the El Paso District poisonous snakes are not common, but their variety is largely due to the diversity in the character of the country. In three seasons I collected 19 green rattlesnakes (*Crotalus lepidus*), 24 black-tail rattlesnakes (*Crotalus molossus*) in the mountains about 5,000 feet elevation, 10 prairie rattlesnakes (*Crotalus confluentus*), 30 Texas rattlesnakes (*Crotalus atrox*) and 2 Edward's Massasaugas (*Sistrurus catenatus edwardsii*) at about 3,500 feet elevation.

From June 1st to September 1st, 1926, H. C. Blanchard collected at Floresville, Texas, 30 miles south of San Antonio, 7,500 pounds of rattlesnakes or about 3,500 snakes, all of which were *Crotalus atrox*. Other field collectors probably shipped 2,500 pounds more. Less than one per cent of the poisonous snakes collected in this district are copper-heads and moccasins. We extracted venom from 1,050 rattlesnakes this season, from late in June, when the station of the Antivenin Institute was opened, up to the present.

The snake catchers are mostly Mexicans and they sell the snakes for about thirty-five cents a pound to the collectors, who call at certain towns each week for the snakes.

During September the snakes are having their young and very few are taken—only about one per cent of the usual catch. The snake catchers are generally picking cotton at that time, as it pays more than snake collecting.

I have collected nine coral snakes (*Micrurus fulvius*) about San Antonio and only one species of rattlesnake—*Crotalus atrox atrox*.

THE MECHANISM OF THE BITE OF THE RATTLESNAKE

When the rattlesnake makes a perfect strike the mouth is opened at an angle of about 70°, the fangs are erected, so as to be at right angles to the roof of the mouth, by the aid of the pterygoid bones and their muscles, and it stabs with the fangs with enough force to penetrate the tissues their full length, which,

in a six-foot rattlesnake, is about $\frac{7}{8}$ of an inch. The venom is excreted through the hollow fangs by compression of the muscles around the venom glands.

THE SYMPTOMS OF THE RATTLESNAKE BITE

(a) Profuse bleeding at bite due to the anti-coagulative action of the venom.

(b) A fiery pain due to the action of the venom on the nerves.

(c) Rapid swelling due to the infiltration of the connective tissue by the passage of blood caused by a venom hæmorrhagin of the nature of a cytolyisin, which causes destruction of the endothelial lining of the smaller blood-vessels near the site of the bite.

(d) Neurotoxic symptoms, nausea and vomiting.

(e) Rapid pulse, sometimes double the normal and followed by very low blood pressure.

(f) Discoloration.

FACTS CONCERNING THE SEVERITY OF THE RATTLESNAKE BITE

The following factors reduce the effect of snake-bites:

(1) The snake missing his goal—the rattler does not see well during the day or before shedding, and may miscalculate the distance and strike a glancing blow without injecting venom.

(2) Diminution in amount of venom, due to (a) hibernation, (b) æstivation, (c) previous exhaustion of the venom in feeding, (d) eaptivity.

(3) Bite being inflicted through clothing that retains some of the poison.

(4) Movement at time of strike making imperfect bite.

(5) Region bitten being very lean, having little connective tissue, as on the finger, toe or shin.

(6) Region bitten being very fat, so that its circulation is poor.

(7) Ejection of part of the venom before the rattler strikes.

(8) Age of the snake—very young or very old specimens produce little venom.

THE ACTION OF THE VENOM OF THE RATTLESNAKE WITH SPECIAL REFERENCE TO EARLY AND LATE SYMPTOMS

The symptoms depend in part on the amount of venom excreted. do Amaral shows

the amount of the venom of our rattlesnake to be about twice as large as that of the cobra. Aeton and Knowles have found that 600 milligrams of cobra venom should kill a man in thirty minutes and 20 milligrams in thirty hours. The primary symptoms in *C. atrox* poisoning are hemolytic and the secondary seem to be neurotoxic.

PHYSIOLOGICAL ACTION OF THE VENOM ON HUMAN TISSUES

The hemolytic action causes a destruction of the red and white blood cells and the proteolytic action the destruction of other tissues. The anti-bactericidal action favors the development of gangrene as a consequence of the bite.

TREATMENT ADVISED BY THE SAN ANTONIO STATION

(a) *First Aid*

Every effort should be made to delay the absorption of the poison or death may result before it can be eliminated by the system or neutralized by an antivenin (serum). Promptness is of primary importance and the quickest first-aid treatment is preferred. Whenever an antivenin cannot be easily secured, the following instructions should be observed:

(1) Apply a tourniquet above bite, where there is a single bone, as the finger, toe, upper arm or thigh. A rubber tourniquet is best. Loosen tourniquet for five seconds, every twenty minutes, until you can reach a doctor, in order to re-establish circulation and prevent gangrene.

(2) Make incision over wound one-third of an inch deep, parallel to the long axis of the limb, with a cross-cut joining fang punctures. This will allow the removal of any loose fang in the wound; the free bleeding will wash out some of the poison and open the wound so that the potassium permanganate may be applied.

(3) Apply a 1:3000 solution of potassium permanganate to bite and keep it soaked with this solution, until you can inject it hypodermically around the bite, to destroy the venom absorbed in the local tissues.

(4) When the heart is greatly depressed it may be stimulated with one-thirtieth of a

grain of strychnine, or one one-hundredth of a grain of nitroglycerine or 5 to 10 minims of a 1:1000 solution of epinephrin hydrochloride.

(b) *Treatment with Serum (Antivenin)*

The San Antonio Station of the Antivenin Institute of America has so far (Sept., 1926) issued serum that was used in twenty-one cases of rattlesnake bite and two of copper-head bite. Owing to the great scarcity of this serum and the numerous cases of snake-bite, it was used only in grave cases where the patient was bitten through the bare skin, as it was found that bites through the clothing were not so dangerous. Anti-crotalic serum prepared in Brazil was used in nineteen cases. A polyvalent anti-bothropic and anti-crotalic serum was administered in four cases, and in one instance one ampul was used for two children, one fourteen months old and one seven years. Two ampuls of monovalent anti-Crotalus-atrox serum were also used.

The cases were usually given first-aid treatment and were not brought to us, nor were we notified, until the patient showed very grave symptoms. It was, therefore, usually ten or twelve hours before we were notified. The first-aid treatment resorted to in the country usually consisted of kerosene oil or, when treated by a doctor, of potassium permanganate. When it was impossible for the patient to be sent here or where the condition of the roads made it impossible to reach the patient in time, airplane transportation was used. A total of 2,600 miles has so far been covered by airplane in hurrying serum to victims of snake-bite. *All cases treated with serum recovered.* Out of thirty cases of rattlesnake bite in central Texas who were not treated with serum, there have been thirteen fatalities reported in local newspapers this summer.

Thanks are due to Major R. E. Scott, M. C., Chief of Laboratories, Fort Sam Houston, for his most valuable assistance. He airplaned 2,600 miles in administering the serum in this district and visited most of the cases treated. Being one of the leading biologists in our Army, his advice was of great value and is duly appreciated.

From the station of the Antivenin Institute, San Antonio, Texas, September, 1926.

6. STUDIES ON AFRICAN OPHIDIA

By THOMAS BARBOUR AND AFRANIO DO AMARAL

For some time evidence has been accumulating that refined taxonomic methods were making it increasingly clear that anomalous cases of geographic distribution are really very rare among reptiles and amphibians. In 1916 Stejneger¹ pointed out that the Ecuadorian and Papuan frogs called by Boulenger *Nyctimantis*, were not congeneric. Recently, Noble,² in an excellent review, has cleared up many more of these anomalies. However, many most improbable distributions are still repeatedly cited. Schmidt³ recently inclines to conclude with Boulenger that certain Neotropical and African snakes are congeneric. This view is at variance with opinions expressed by Stejneger⁴ and Barbour⁵ with regard to *Leptodeira* in America being replaced by *Crotaphopeltis* in Africa. The latter opinion we now endorse.

The great increase in the amount of material available for study in the Museum of Comparative Zoölogy has made possible the determination of several other doubtful points. We have found, for instance, that *Apostolepis gerardi* Boulenger⁶ is not congeneric with the American species. This fact, already suspected by us to be true, was confirmed unexpectedly while reading G. D. Hale Carpenter's⁷ "A Naturalist in East Africa." Here he describes briefly and figures a second record specimen of this rare form taken by him at Ankwahe, Portuguese East Africa, and now in the British Museum. The African form differs from those of South America in having a much shorter head and much smaller mouth opening, 4 labials instead of 6; nasal completely separated from preocular by the prefrontal, which is widely in contact with the second labial. The African genus henceforward should stand as *Parkerophis*, type *gerardi* Blgr., its name being given in honor of our friendly correspondent, Mr. H. W. Parker, of the British Museum. This conclusion not only disposes of an incredible anomaly in distribution, but allows us to point to one of the most striking examples of parallel development both in form and coloration which exist among reptiles.

The African species of *Notrix*, several of which we have already examined, surely fall into one or more fairly distinct groups, as Wall has shown some of the East Indian species to band themselves. *Helicops* is a composite genus, the Neotropical species which are decidedly different from the Nearctic apparently being also distinct from the African and Indo-Malayan. The following notes serve to corroborate some of our conclusions:

LEPTODEIRA

According to our considerable field experience and examination of very large preserved series, we incline to believe that this distinct American genus may be monotypical. Our studies confirm Griffin's⁸ opinion as to *L. albofusca* (Lacépède) being a synonym of *L. annulata* (Linné),⁹ and it is not improbable that the other species, viz., *L. punctata* (Peters), *L. nigrofasciata* (Günther), *L. frenata* (Cope), *L. septentrionalis* (Kennicott), *L. personata* (Cope), *L. ocellata* (Günther) are likewise synonyms. The two species last named are almost certainly invalid. Indeed, the one which may be retained is *septentrionalis*, of which, however, we have only a few young specimens. The principal form is extremely variable. In life it is nocturnal, usually inoffensive but sometimes aggressively snappish. It feeds usually upon amphibians but not infrequently also upon lizards, especially in arid or semi-arid areas where the preferred amphibia are rare. The generic characters may be summarized thus:

Leptodeira Fitz.: type *annulata* Linné. Maxillary teeth 16 gradually increasing posteriorly, a wide diastema and then 2 much enlarged grooved teeth. Hemipenis, undivided, with unforked sulcus, with the distal end capitate, with the superior third provided with small deep, numerous calyces, having micro-serrate borders; the middle third with numerous small sharp spines, the basal third with minute spines. Chin shields in two pairs; one to three rows of gulars. Scales in 19 (rarely 17) to 25 rows; vertebrals not en-

larged; ventrals 150-215; anal divided. Tail rather long, subcaudals double, 55 to 110 pairs.

This diagnosis was based upon male specimens which from time to time had been studied and labeled as *L. annulata*, *L. albofusca*, *L. nigrofasciata*, and *L. yucatanensis*.

CROTAPHOPELTIS

This form is also most probably monotypical, *Leptodeira tornieri* Werner (1895) from Usambara having been referred to *rufescens*⁹ which is a synonym of *hotamboeia* Linné. There seems to be no reason to suppose that the same is not true also of *L. degeni* Boulenger (1906) from Uganda and *L. attar-ensis* Werner (1907) from the Sudan. The generic characters may be defined as follows:

Crotaphopeltis Fitz.: type *rufescens* Schlegel = *hotamboeia* Linné. A wide ranging species over the savannah areas of tropical and southern Africa, at times semiaquatic and feeding largely at least upon amphibia. Maxillary teeth 16, feebly enlarged posteriorly, a very short diastema and then two enlarged grooved teeth. Hemipenis undivided, with sulcus unforked, non-capitate; with only a few shallow calyces (2 or 3 rows) confined to the top and with borders smooth, crenellated, the basal two-thirds with large, blunt irregular spines which become minute at the base of the organ (Cope's fig. in Trans. Amer. Philos. Soc., 18, 3, 1894, pl. 30 fig. 8 is inaccurate for the top of the hemipenis is not shown). Chin shields 3-4 pairs, gulars none. Scales in 19 (rarely 17) rows, vertebrals not enlarged. Ventrals 140-180, anal entire; tail short, subcaudals in 30-55 pairs.

DIPSADOBOA

A well-defined genus of two valid species so far known. The one apparently characteristic of the forest floor, i. e., *D. unicolor*, the other a forest form apparently arboreal, *D. elongata*. Both species are confined to tropical West Africa. The former feeds upon toads and frogs, the latter probably upon tree frogs. The generic characters compare with those previously cited as follows:

Dipsadoboa Günther, type *unicolor* Günther, monotypical when proposed. The second

species is *L. elongata* (Barbour, 1914). Maxillary teeth 19 subequal + 2 much enlarged and grooved, after a long diastema, in *unicolor*, and 20 + 2 similarly arranged in *elongata*. Hemipenis undivided, with unforked sulcus, non-capitate, with calyces of medium size and depth on the superior third, the borders concave, thus forming tiny teeth at their meeting points; spines of middle third medium and base smooth in *elongata*; spines in *unicolor* about one-half sharp and one-half rather blunt. Chin shields in 2 pairs; gulars 2 rows (*unicolor*), 3 rows (*elongata*). Scales in 17 rows, the vertebral row slightly enlarged. Ventrals 186-227, anal undivided, tail rather long, 62-110 subcaudals which are single.

DIPSOLYPHOPHIS gen. nov.

This genus will include two forest living forms recently described of which we have specimens, viz., *Leptodeira guineensis* Mocquard, 1920, from Dieke, French Guinea, and *Leptodeira duchesnii* Boulenger, 1901, Upper Congo. It is very probable that here also belongs *Leptodeira nigeriensis* Werner, 1912, from the delta of the Niger River. We define the genus as follows:

Dipsoglyphophis gen. nov., type *L. guineensis* Mocq.

Maxillary teeth 19 (in *duchesnii*) and 21 (in *guineensis*), distinctly increasing posteriorly, a long diastema and then 2 much enlarged grooved teeth. Hemipenis undivided, with sulcus unforked, non-capitate, calyces numerous, small, deep, those of the upper third with denticulations formed at the meeting place of the edges, the base with small sharp and abundant spines. Chin shields 2 pairs, gulars in 2 rows (*duchesnii*) or 1 row (*guineensis*). Scales in 17 rows, vertebrals not enlarged, body long, ventrals 201-224, anal undivided or divided;* tail rather long, subcaudals in pairs, 72-114.

TARBOPHIS

Studies of species of *Tarbophis* have also led to some interesting conclusions. The genus is a large one and we have not seen all the species by any means, but apparently

* In the type the anal was divided, but in Müller's series (Abh. Bayer. Akad. Wiss. XXIV:605, 1910) and in Schmidt's two specimens (Bull. Am. Mus. Nat. Hist. XLIX:109, 1923) it was entire.

the genus may be divided according to the habitat preferences of the species.

Desert forms: *fallax syriacus* Boettger; *iberus* Eichw.; *rhinopoma* Blaut.; *guentheri* Anders.; *obtus* Reuss; *tessellatus* Wall; *guidimakaensis* Chaban; *beetzii* Barb..

Forest forms: *semiannulatus* Smith; *variegatus* Reinh..

Intermediate: *fallax fallax* (Fleishmann); and *fallax cyprianus* subsp. nov.

When Boettger proposed the form *syriacus*, his series was composite and contained also specimens of *fallax fallax*. We restrict the name to the race inhabiting southern Syria and adjacent Lower Egypt.

The points of distinction of the four genera first mentioned above may be tabulated as follows:

	Leptodeira	Crotaphopeltis	Dipsadoboa	Dipsoglyphophis
Maxillary teeth....	16—wide diastema +2	16—very short diastema +2	19—wide diastema +2	19 or 21—wide diastema +2
Dorsal scales.....	19 (17)—25, vertebral row not enlarged	19 (17), vertebral row not enlarged	17, vertebral row slightly enlarged	17, vertebral row not enlarged
Tail.....	rather long	short	rather long	rather long
Subcaudals.....	55–110 pairs	30–55 pairs	62–110 single	72–114 pairs
Chin-shields.....	2 pairs	3–4 pairs	2 pairs	2 pairs
Gulars.....	1–3 rows	none	2–3 rows	1–2 rows
Hemipenis.....	undivided	undivided	undivided	undivided
sulcus.....	unforked	unforked	unforked	unforked
distal end.....	capitate	non-capitate	non-capitate	non-capitate
calyces.....	numerous, small and deep, with micro-serrate borders	rare, shallow with smooth or crenellated borders	more or less numerous, with concave borders forming teeth at their confluence	numerous, small and deep, with borders denticulated at their confluence

The three recognized races of *Tarbophis* may be defined and their ranges stated as follows:

Subspecies	Sc.	Post-chin shields	Dorsal spots	Distribution
<i>fallax syriacus</i>	19	narrowly separated; not rounded contours	not numerous; dorsal series not separated from lateral by dark elongated stripe-like markings	S. Syria, Lower Egypt
<i>fallax fallax</i>	19	± widely separated; rounded contours	numerous; not separated	N. Syria, Asia Minor, Greece, Dalmatia, Illyria
<i>fallax cyprianus</i> subsp. nov.....	21	± widely separated; not rounded contours	numerous separated (markings more regular)	Cyprus

Type: Sc. 21
V. 300½, A. 2, C. 64/64 ♂.

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Cambridge, Mass.
January, 1927

7. STUDIES OF NEOTROPICAL OPHIDIA

VI. A NEW GENUS OF SNAKES FROM HONDURAS

By AFRANIO DO AMARAL

In his recent report entitled "Snakes of the Ulua River Valley," Dr. Herbert C. Clark, of the Medical Department of the United Fruit Company, published the results of a snake census made under his direction at Tela, Honduras, from July, 1924, to October, 1925. As Dr. Clark wrote, "interruptions in the work, however, occurred in the months of February and March, 1925. The total period of actual time consumed was 14 months, and the months of July, August, September and October represent catches during both years. Specimens collected during 'dry season' form a very small part of the total catch, for two reasons: First, there is no cutting of the grass, weeds, vines, etc., in the banana plantations during 'dry season,' in order that all the moisture possible may be conserved for the growth of the fruit. This system deprived us of the 'cleaning gangs,' who caught most of the snakes, and left at work only the small fruit-cutting and transportation gangs on the farm. These laborers have very little chance to see snakes on the ground, because of the reptiles' opportunity to conceal themselves in the dry-season growth. The second reason, apparently, is that many of the snake species hide away during their breeding season."

Notwithstanding all of these drawbacks in the work, 3,438 specimens of snakes were captured at the different plantations that occupy the land in the immediate vicinity of the South bank of the Ulua River on the Caribbean Coast of Honduras. All of those 3,438 specimens were shipped for identification to the Museum of Comparative Zoölogy of Harvard University, where I recently had the opportunity of examining a few of them. Poisonous snakes of both the solenoglyph and the proteroglyph types, are represented by 17.4 per cent of those (3,109) specimens whose identification has thus far been reported.

Now, if we take into consideration the fact

* For previous Studies see: No. I in Proc. N. E. Zool. Club, IX, 1924; No. II in Proc. N. E. Zool. Club, IX, 1926; No. III in Proc. Biol. Soc. Washington, 39, 1926.

that at the time that census was made the natives and the laborers in general working for the United Fruit Company were not familiar with collecting snakes and also that the "Barba amarilla" (*Bothrops atrox*), the main type of poisonous snakes of the district, is likely not to be frequently found during the period the work at the plantation is going on, as it usually comes out to seek its food at night, we can perhaps guess how many more snakes may be found at that particular region.

As a result of Dr. Clark's work, a Station, consisting of a laboratory and a "serpentarium," has been recently organized in Honduras by the joint efforts of the United Fruit Company, the Herpetological Department of Harvard University and the Antivenin Institute of America and it is expected that through the work of propaganda and teaching to be carried on by the new organization among the natives as well as through the probable increase in the area under cultivation at Tela, the snake catches there will gradually increase to exceptionally high figures.

Among the Hondurian snakes I recently examined at the Museum of Comparative Zoölogy there is a specimen that appears to represent a genus and a species new to science so that I am describing it now, in anticipation of a more detailed study of that collection to be published in the near future by Dr. Thomas Barbour and his Assistant, Mr. Arthur Loveridge. The new form may be defined as follows:

LEPTODRYMUS gen. nov.

Head elongate, slightly distinct from neck; eye large, with round pupil. Maxillary teeth 16 + 1 (17), subequal, slender and very sharp, in a close series (isodont type); mandibular teeth small, subequal. Body elongate, slender, cylindrical; scales smooth, with double apical pits, in 17 rows, all disposed longitudinally, very slightly increasing toward the belly; ventrals and subcaudals obtusely keeled laterally. Tail long, slender (injured in the type); subcaudals in 2 rows.

Leptodrymus is close to both *Drymobius* Fitzinger and *Leptophis* Wagler through its dentition, physiognomy, shape and pholidosis.

LEPTODRYMUS CLARKI sp. n.

Fig. 10, A.

Snout rounded, scarcely projecting. Eye two-thirds as long as the snout (4:6). Rostral broader than deep, visible from above; internasals as long as broad, as long as the prefrontals which are broader than long; frontal once and half as long as broad, a little longer than its distance from the end of the snout, a little shorter than the parietals (6:7); nasal divided, posterior as long as, but somewhat deeper than, the anterior; loreal low, twice as long as deep; one preocular, narrowly separated from the frontal; three postoculars; temporals narrow, 1 + 2, subdivided ($\frac{1}{1} + 1\frac{1}{1} + \frac{1}{1} + \frac{1}{1}$); nine upper labials, 6th, 7th, 8th, and 9th larger, 4th (only slightly), 5th and 6th entering the orbit; five lower labials contiguous to the anterior chin-shields which are shorter than the posterior (4. 5:6). Scales

in 17 rows. Ventrals 200; anal divided; subcaudals 58 p. + n. (probably about 90 to 100).

Back bluish gray, which color extends down to the ventral and subcaudal keel; head bluish above; a black stripe running from the nostril, through the temporal and paravertebral region to the end of the tail, covering the 6th and 7th and half of the 5th and 8th rows of scales, and separated from its fellow by the vertebral and the internal half of the 8th rows, which are bluish gray.

Total length—750 mm. + n.; tail 150 mm. + n.

Type.—♂, No. 20,207 in the Museum of Comparative Zoölogy, Cambridge, Mass.; sent from Toloa Creek, Tela, Honduras, on March 19, 1925, by the then Laboratory Director of the Tela Hospital of the United Fruit Company, Dr. Herbert C. Clark, in whose honor the species is named.

Hemipenis—not capitate, with apical calyces; sulcus unforked; spines very long and strong (2 close to the sulcus extremely long), rapidly decreasing superiorly until they change into fringed papillae that circumscribe numerous small calyces (Fig. 10, B).

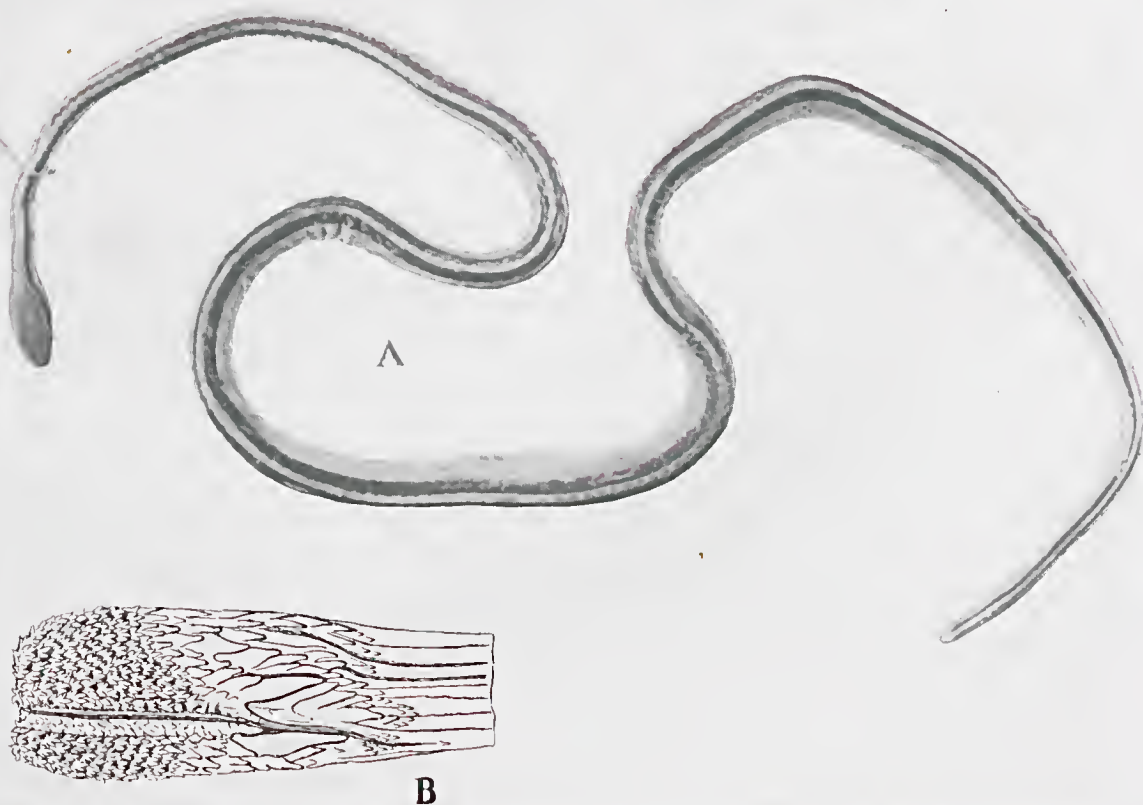


FIG. 10.—A, Photograph of the Type Specimen of *Leptodrymus clarki* n.g., n.sp., No. 20,207, Museum of Comp. Zoölogy. B, its hemi-penis (X3).

Bulletin of the Antivenin Institute of America

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NO. 2

Edited by

✓ AFRANIO DO AMARAL and R. H. HUTCHISON

WITH THE COLLABORATION OF OTHER MEMBERS OF THE STAFF OF THE INSTITUTE

The BULLETIN contains scientific contributions to, and current information on, the relation of snakes and other poisonous animals to man, with special reference to the highly venomous species of North and Central America, the West Indies, and northern South America. The subject matter covers taxonomy, biology and geographical distribution of species; the economic and public health aspects of the snake-bite problem; the collection of venoms, their composition, properties, and physiological effects; the production of antivenins; and related serological and immunological problems.

Address all communications to the BULLETIN OF THE ANTIVENIN INSTITUTE OF AMERICA, Box 1404, Philadelphia, Pa.



✓ 8. THE SNAKE-BITE PROBLEM IN THE UNITED STATES AND IN CENTRAL AMERICA¹

By AFRANIO DO AMARAL

Responding to a request from the Medical Department of the United Fruit Company, I am offering a short report on the progress of the Antivenin Institute of America. I am also submitting, concerning the management of snake-bite cases, some instructions that may be passed on to the various divisions of the United Fruit Company so that they can not only standardize their procedure in the care of such cases but also be of some assistance to our Antivenin Institute.

Early last summer I motored through the United States, especially the south and west, with the idea in mind of finding out how serious the snake-bite problem is in those sections. Advantage was taken of this opportunity to show

as many laborers, farmers, and campers as possible what they should do to prevent snake-bites. I think I proved to them, quite conclusively, that in the majority of cases the use of heavy shoes and leggings affords one very good protection, not only against poisonous serpents, but also against the hookworm, which represents another scourge of mankind in the Tropics and sub-Tropics. These people have been advised not to destroy systematically all snakes that they encounter, but to catch and deliver alive to a serpentarium the poison species. These species are indispensable in the preparation of antivenin. The non-poisonous snakes should be spared for they are of great benefit, as a rule, in the farming regions because they live mostly on rats, mice, moles, and other rodents that are pests to agriculturists.

✓ ¹ Reprinted with permission from the 15th Annual Report of the Medical Department of the United Fruit Company, 1926.

Through the experience gained on my trip and the study that I made of all available statistical data, I have come to the conclusion that there are annually, in this country, more than 1,000 cases of snake-bite by poisonous species. I believe that the mortality rate in such accidents runs from 10 per cent in the northeast, middle west, and northwest, to 25 per cent in the southeast and 35 per cent in the southwest. The number of bites is greater in the southwest than anywhere else in the United States. Ophidism is becoming more and more of a problem in the United States, as well as in Central America, because of a number of circumstances that operate in the same direction:

1. The clearing of the primitive jungle growth (contrary to general opinion) is followed by a rapid increase in the number of snakes, provided that agricultural development follows the clearing of the jungle.

2. Successful agricultural development produces an abundant and easily accessible supply



FIG. 1. "Fer-de-lance," *Bothrops atrox*. Specimen from Honduras, Central America. Profile view, photo from life.

of food and shelter for rodent life, thus causing it to multiply. Particularly is this true regarding the rats which form the chief article of diet for the vipers in North and Central America. This circumstance, in turn, influences the breeding of such snakes in the lowland plantations.

3. A primitive jungle area or a neglected district is practically an unpopulated region, but the agricultural development of such areas is naturally associated with an influx of population that consists largely of field laborers. Thus, obviously, the chances for snake-bites are enhanced.

It is a curious fact, but nevertheless a natural sequence, that progress in agriculture generally aggravates the dangers of ophidism by markedly contributing toward the numerical increase of human beings, rodents, and serpents, the three main factors involved in the problem. Agricultural pursuits also introduce the use of a large number of domestic animals that are exposed to the danger of snake-bite. Unfortunately, sta-

tistics are far from complete regarding such accidents among domestic animals. I learned while traveling through the southwest that in Texas alone, during the last two or three years,

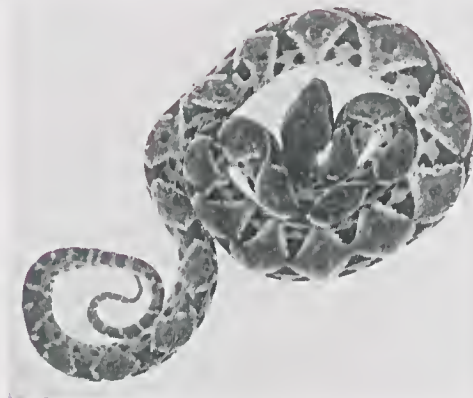


FIG. 2. "Fer-de-lance," *Bothrops atrox*. Specimen from Honduras, Central America. Seen from above.

snake-bite has been responsible for an annual loss of over one million dollars' worth of cattle.

The Antivenin Institute of America has been recently organized, as a subdivision of the Mulford Biological Laboratories, to face the problem of snake-bite in all its aspects. It has the hearty encouragement and support of a few broad-minded, progressive individuals and of certain educational, scientific, and commercial organizations. Among the individuals actively interested are: Dr. Thomas Barbour, of the Museum



FIG. 3. "Eyelash viper" or Horned Palm Viper, *Bothrops schlegelii*. Specimen from Panama. Courtesy of Dr. T. Barbour and Mr. G. E. Nelson of the Museum of Comparative Zoölogy.

of Comparative Zoölogy, Harvard University; Mr. Raymond Ditmars, of the New York Zoölogical Park; Col. Martin Crimmins, U. S. A., Ret.; Maj. Raymond Scott, M. C., U. S. A.; Mr.

Lawrence Klauber, of the San Diego Zoological Park; and Dr. William Scheppegrell, of the New Orleans Zoological Park.

The institutions supporting the project are: The United Fruit Company, the New York Zoological Society, the Philadelphia Zoological Society, and the Zoological Society of San Diego.

The organization of the Antivenin Institute of America, as it stands at present, appears in the inside cover of this BULLETIN.²

It did not take very long for our North American stations to be placed on a complete operating basis by the competent assistants in charge. They have succeeded—July to October, 1926—in obtaining venom from over 4,000 rattlesnakes, as well as from many copperheads and moccasins. Moreover, in order to reach people bitten by snakes far in the country, and give them serum, the Army and Navy aeroplanes, working in connection with our stations in the southwest, flew more than 3,000 miles this year. It seems fair to anticipate that the anti-ophidic campaign in this country will become even more successful than it has been in Brazil.

THE WORK IN CENTRAL AMERICA

In regard to our work in Central America, it is hoped that the different divisions of the United Fruit Company will continue to show increasing



FIG. 4. The Hog-Nosed Viper, *Bothrops brachystoma*. Specimen from Honduras.

interest in the snake catches and in the careful observation of their cases of snake-bite. The assistance they have already given our representative, Mr. Douglas March, in charge of our

² In the Annual Report of the Medical Department of the United Fruit Company the organization was given in detail in the text.

Serpentarium and Laboratory, at Tela, Honduras, is indeed very encouraging. I believe their work will be even more useful and profitable if they always endeavor to have their plantation laborers capture the poison snakes



FIG. 5. The Bushmaster, *Lachesis muta*. Photograph obtained through courtesy of Raymond L. Ditmars.

that they encounter and send them to the Serpenterium, where they can be made of scientific use.

The following instructions should be followed in cases of snake-bite:

1. *Catch the snake that caused the accident.* The identity of the species must be known, if the correct specific antivenin is to be used in the treatment of the case. Without this knowledge, the treatment of the case will be less successful, and our statistics can not be made complete and scientific. Each division can thus receive due acknowledgment for its contribution toward the advancement of science, since any specimens that are collected will be utilized, also, in the study of the geographical distribution of species and their relative incidence and economic importance.

2. *Apply a tourniquet above the knee or elbow whenever the bite is located below these levels.* More than 75 per cent of the bites occur on the feet, ankles, hands, or wrists. For a tourniquet, almost anything like strings, strips of clothing, vines, etc., can be used. The tourniquet should be applied firmly enough to prevent the flow of blood in the veins, but not tightly enough to prevent the flow through the artery. In other words, tie it tightly enough to cause the limb to become blue, but not white or blanched. The tourniquet should be released for a few seconds, at intervals of ten minutes, in order to prevent gangrene of the tissue below the level of the constriction.

Applied below the knee or below the elbow, a tourniquet can not be as successful, because the flow in veins that lie between the bones of the leg or forearm cannot be as effectively controlled.

Remember that some of the serious results from snake-bite are due more to severe, long-continued constriction by the tourniquet than to the toxic property of the venom itself.

3. *Send the patient (and also the snake, for its identification) immediately to the hospital where proper care and treatment can be instituted.* Telephone that the case is on the way from a given station, for sometimes the snake-bite occurs at such a great distance from the hospital that too much time is lost before the antivenin can be administered. It may, at times, be very necessary for a doctor to go out and meet the patient somewhere along the line, in order to administer

sions are most liable to be exposed are the following:

1. *Bothrops atrox* (Figs. 1 and 2) is generally known as the "fer-de-lance," but it is also locally called "terciopelo," and "barba amarilla." It is perhaps the most abundant of the dangerous reptiles to be found in the mainland divisions, from Colombia to Guatemala. In Honduras, it is found in especially large numbers.

2. *Bothrops schlegelii* (Fig. 3). This is more commonly known as the "horned palm viper," but it is also known locally as the "bocaracá," "toboba de pestanas," "oropel," and "sleeping gough." It is nearly always found in a small tree or bush.

3. *Bothrops brachystoma* (Fig. 4), the hog-nosed viper, is also known as the tamagá.

4. *Lachesis muta* (Fig. 5) is generally called



FIG. 6. The neotropical rattler, *Crotalus terrificus*. Specimen from Colima, Mexico. Photographed from life.



FIG. 7. Coral snake, *Micrurus nigrocinctus*, from Central America. Specimen from Panama.

treatment soon enough after the accident to prevent serious results.

The doctor who makes such a trip should take with him a tube of each type of antivenin carried in stock, in order that he may be prepared to select the proper one after identifying the species. The injection of the antivenin may be given hypodermically or intravenously, according to the severity and duration of the poisoning. Stimulants, such as strychnine and caffeine, may also be given when indicated, but avoid the use of alcohol.

The modern treatment in snake-bite poisoning requires that the doctor be able to recognize the young and the old specimens of the poison species in his locality, in order that he may safely select the antivenin for any given case.

The species of poison snakes to which the inhabitants of the United Fruit Company divi-

sions are most liable to be exposed are the following:

5. *Crotalus terrificus* (Fig. 6), commonly known as the rattlesnake, bears the local name of cascabela. It is believed to be rather common in Colombia, and has been less frequently reported in the other mainland divisions. Usually it is found at an altitude higher than that of the banana plantations in the Central American divisions.

6. *Micrurus nigrocinctus* (Fig. 7), the coral snake, is found in Colombia, Panama, and all other Central American mainland divisions. It seldom bites. This species is also known as the harlequin snake and the gargantilla.

Antivenins are usually prepared in such a manner that one commercial product will cover

the needs of treatment for the bite of several species of snakes. For instance our bothropic antivenin can be successfully used for the bite of the following snakes: the fer-de-lance (barba amarilla, terciopelo); the toboba (horned palm viper, bocaracá, oropel, sleeping gough); the tamagá; and the lora.³ Each of the following species, however, requires its specific antivenin: the bushmaster, cascabela, and coral snake.

What has just been said will clearly indicate the necessity of knowing what species of poison snake is responsible for any particular accident. Furthermore, I can never over-emphasize the

necessity of capturing as many of the local poison snakes as possible, since it is my experience that one single New-World, truly venomous snake, to whatever genus it may belong (*Agkistrodon*, *Bothrops*, *Sistrurus*, *Crotalus*, or *Lachesis*), if properly handled, will surely give enough venom to prepare sufficient antivenin for the cure of at least four or five snake-bitten people.

We hope to issue at a later date a pamphlet illustrating, in colored plates, the poison snakes of the north coast of South America, as well as of Central America and the United States. A brief account of the toxic properties of each species will also be given.

9. CASES OF SNAKE-BITE TREATED IN ALMIRANTE HOSPITAL, PANAMA, THE YEARS 1922-26, INCLUSIVE⁴

By H. R. EICHELBAUM, M.D.

Almirante Hospital, Panama

The number of snake-bite cases treated in this hospital from 1922 to 1926, inclusive, was very small compared to the number of persons admitted for other accidents and for diseases.

Snakes are numerous here, but they are encountered mainly by the laborers at work on the plantations. Our medical records probably do not reflect correctly the incidence of snake-bite accidents. A trustworthy "curandero" recently told me that he had treated 81 cases of snake-bite that had occurred in this locality during the past two years! A number of these so-called snake-doctors exist in our region, and they all are alleged to have treated a certain number of such cases. One of these specialists maintains a clinic in Guabito and advertises himself each week in the local newspaper, offering a form of snake-bite insurance to his patrons at the rate of fifty cents a month!

Various reasons exist to explain why our hospital treatment is neglected or discredited in cases of snake-bite. Some of these explanations might be listed as follows:

1. The party bitten is usually an uneducated laborer who is at a great distance from the

hospital at the time of the accident. He may either recover or die before he can reach the hospital.

2. Many snake-bite accidents are not followed by serious results. Either the snake was not a poison species or, if it was, at the time it struck the individual it had empty glands, as a result of a recent ingestion of its food. Most of our poison snakes are *night feeders* and our men are usually bitten in the daytime by a snake that has fed during the previous night.

3. We have never been prepared, until recently, to offer scientific treatment with a specific antivenin, and this fact, together with the others just mentioned, has permitted the local snake-doctor to build up quite a reputation in the management of such cases.

The venomous species that are believed to exist in the Province of Bocas del Toro, Panama, are listed below:

1. Terciopelo, or fer-de-lance (*Bothrops atrox*)
2. Bushmaster (*Lachesis muta*)
3. Coral snake, or harlequin snake (*Elaps fulvius*)⁵
4. Bocaracá, toboba de pestanas, sleeping gough, or the horned palm viper (*Bothrops schlegelii*)
5. Tamagá, or hog-nosed viper (*Bothrops brachystoma*)
6. Cascabela, or rattlesnake (*Crotalus terrificus*)

³ Common name of *Bothrops lateralis*—Ed.

⁴ Reprinted with permission from the 15th Annual Report of the Medical Department of the United Fruit Company, 1926.

⁵ This species is now called *Micrurops nigrocinctus*—Ed.

That member of the list found in greatest numbers, and believed responsible for most of our serious cases of snake-bite poisoning, is the terciopelo or fer-de-lance.

A review of the total of 25 cases treated in the hospital from 1922 to 1926, inclusive, is given below:

- 2 patients were bitten by *L. mula* (bushmaster). Both of these patients died.
- 3 patients were bitten by *B. atrox* (terciopelo, or fer-de-lance). One of them died.
- 4 patients were bitten by *B. brachystoma*? (tamagá, or hog-nosed viper?). No deaths were reported.
- 2 patients were said to have been bitten by the coral snake (*Elaps fulvus*).⁵ No deaths reported.
- 4 patients were bitten, possibly, by the bushmaster or the fer-de-lance. One of them died.
- 2 patients were bitten, possibly, by coral snakes. No deaths noted.
- 8 patients were bitten by unknown species of snakes. Two of them died.

Twenty-four of the people bitten were men, and the other was a woman. The 1 woman and 5 of the men died.

The 25 cases by race show: negroes, 12; mestizoes, 9; Indians, 4.

The victims were struck on the leg or the foot in 15 of the cases, and on the hand in 10 of the cases.

In 14 of the cases, there was local oedema, with discoloration about the region of the wound and oozing from the fang punctures; associated with this, there were haematuria and bleeding from the lungs, gums, nose, and intestines. Gangrene developed in a wide area about the fang punctures in 3 of the cases, and there were 4 others which developed only local oedema at the side of the bite with an associated feeling of drowsiness. In 7 other cases there was local oedema at the site of the wound with no constitutional symptoms.

AUTOPSY RECORD ON A FATAL CASE

(Species of viper not stated)

Rigor of death noted.

Fang punctures were found on the leg. The skin and subcutaneous tissue in the region of the fang marks were necrotic, and the entire leg was oedematous and discolored. Local haemorrhages were present in the skin. The blood in the large vessels, four hours after death, was in a fluid state.

Oesophagus, thyroid gland, and aorta were normal.

Heart.—Contracted ventricles. Epicardium and endocardium were dotted with ecchymoses. The muscle was anaemic and had a "boiled color" appearance.

Lungs.—The pleura covering the lower parts showed petechiae, and there were a few small haemorrhagic infarcts. The bronchial trees were filled with blood-stained fluid, and a similar fluid escaped from the cut surface of the parenchyma.

Spleen.—Slight enlargement noted. The Malpighian bodies were visible.

Kidneys.—The peri-renal tissues showed a bloody extravasation. The parenchyma presented a waxy appearance, and the glomeruli and tubules were visible macroscopically. The adrenals were negative.

Liver.—The cut surfaces presented a yellowish color, and there seemed to be a definite fatty change present.

Stomach was dilated and filled with bile-stained fluid. Haemorrhages were visible in the mucosa.

Pancreas.—Negative.

Intestines.—Haemorrhages were visible in the mucosa.

Bladder.—A small amount of bloody urine was present.

MICROSCOPIC PATHOLOGY (DR. MALLORY)

Lungs.—Partly collapsed. A little serous exudate in some of the alveoli. Extravasated blood and ghost cells of erythrocytes in most of the alveolar spaces. The tunica intima is missing or fragmented in most of the blood vessels. The adventitia and media were apparently normal. The congested capillaries contain numerous hyaline, fibrin thrombi.

Spleen.—Congested. Slight toxic reaction in the centers of some of the lymph nodules. Endothelial leucocytes containing nuclear fragments. Moderate infiltration with eosinophiles.

Liver.—Congested. A few fibrin thrombi in sinusoids. Extravasated blood in many places. Focal necrosis present. The Kupffer's cells are laden with cell detritus and blood pigment. Some infiltration with lymphocytes around the portal vessels.

Kidneys.—Congested and oedematous. Each of the Bowman's capsules contains some blood pigment and fibrin. The pigment increases downward along the medullary rays as far as the collecting tubules. The latter are entirely filled with this material. The epithelium of the tubules is partly necrotic and fills the lumina. The endothelial cells lining all the blood vessels show marked degenerative changes, while in some of the vessels, large enough to have three coats, the cell space relationship and staining properties have undergone marked changes.

Skin.—Extensive diffuse haemorrhages.

There seems to be a general hyalin thrombosis of most of the organs.

Since we have been supplied with the Brazilian antivenins we have been able to treat 15 of the cases included in this series of 25. We used antivenin No. 2 or No. 3 in all the cases. Death occurred in 2 of the 15 cases treated. One of these fatal cases did not receive treatment until 4 days after being bitten. He died within an hour after reaching the hospital. The other fatal case was not treated until 50 hours after the biting had occurred. The people who recovered were treated within from 30 minutes to 8 hours after being bitten.

10. SNAKE-BITES

SPECIAL REPORT FROM PUERTO CASTILLA, HONDURAS⁶

By B. M. PHELPS, M.D.

SCARCITY OF HOSPITAL CASES

Unverified reports have come to us concerning snake-bite cases that have occurred in the remote parts of our division. Since very few victims of such accidents are received for treatment in our dispensaries or in the hospital, we were led to investigate the reports. We asked for information through the channels of the Departments of Agriculture and Engineering. The following report was received on December 21, 1926, from the Chief Engineer and Superintendent of Railways: "We have had no case of snake-bite during the year 1926."

The Department of Agriculture received a report from one of its farm overseers, who stated that he had heard of a man being bitten by a snake, but was unable to obtain information about the species, the kind of treatment employed, or the result of the accident. The Black River District also reported that three men had been bitten during the year. Two of these men were treated by local "snake-doctors," and both died. The third man was sent to the hospital for treatment. The following is a detailed report of this case:

CASE REPORT

Case.—Male, Honduranian, age 40 years.

Personal History.—He stated that while he was bending forward, cutting brush, a snake struck his leg. He killed the snake, which was about 3 feet long, and carried it to the camp, where some one told him that it was a *Barba amarilla* (Fer-de-Lance). It was not sent to the hospital for identification. About an hour after the accident the man returned to the camp, where another man gave him

some kind of medicine. Two hours after the accident, the entire foot, leg, and thigh became swollen. He had pain in the leg at first, but later—about 24 hours, after receiving the bite—there was a loss of sensation to pain and touch, all over the foot and leg; at this time there was also some bleeding from the gums. These conditions lasted about 6 hours.

Physical Examination.—Patient was a well-developed and well-nourished man. Two small puncture wounds were found, with a space of $\frac{1}{2}$ inch between. These fang marks were located on the external surface of the right thigh, 3 inches above the knee joint. A red area about 2 inches in diameter had developed around the punctures. Sensation of pain was diminished over the dorsum of the foot and the entire leg, and there was a partial loss of sensation over the external surface of the thigh. Patient complained of pain, on pressure, over the upper, inner surface of the thigh. He had a few decayed teeth, and the gums were spongy but showed only a slight tendency to bleed, on pressure. Spleen was enlarged to 3 fingers below the costal margin.

Laboratory Reports.—No malarial parasites were found. Urine findings were normal. Stool was positive for hookworm.

Treatment.—Patient was given one ampoule of antithrotoph serum a few minutes after his admission to the hospital; 5 hours later he was given 2 ounces magnesium sulphate. A liquid diet was ordered.

Progress Notes.—Temperature, on admission, was subnormal and pulse rate 60. Temperature never rose above normal, and pulse rate never above 72.

November 27.—Improvement in sensation was noted, the day after admission, over the foot, most marked on the medial surface, and over the external surface of the thigh. Patient complained of dizziness, at times.

November 28.—Sensation was practically normal over the foot, leg, and thigh. He complained of weakness and dizziness and sharp pain in the wound at times.

November 29.—Complained of weakness.

November 30.—Wound had healed. No complaint.

This man was kept in the hospital for 7 days, and was given the chenopodium treatment for hookworm. He was discharged, as cured, on the 8th day. Readmitted on January 3, 1927, to be treated for machete wounds, he reported that no further symptoms from the bite developed after his discharge from the hospital.

⁶ Reprinted with permission from the 15th Annual Report of the Medical Department of the United Fruit Company, 1926.

11. REPORT OF SNAKE-BITE CASES⁷

By R. B. NUTTER, M.D.

Tela Hospital, Tela, Honduras

The following cases of snake-bite poisoning that occurred within the limits of our Division during the present year are herewith submitted:

CASE 1

Case History.—No. 4,156.

Admitted to hospital March 6, 1926, at 6.15 p.m., 25 hours after the accident had occurred.

History.—While walking along the railroad track in the Guaymas district, about 5 p.m. on March 5, 1926, the patient was bitten by a snake. It struck him on the base of the left, fourth toe. He states that the reptile was about 4 feet 6 inches long, with a rough skin and diamond markings. He is sure it was a barba amarilla (fer-de-lance). The snake was not killed.

First Aid.—The wound was incised and cauterized on the morning of March 6, 1926, at the Guaymas dispensary. A tight bandage had been applied as a tourniquet above the ankle and below the knee.

Symptoms.—There was bleeding from the nose and mouth about 3 hours after he was bitten. He continued to expectorate bloody saliva, and blood oozed from the nose. There was no pain or vomiting, and only a moderate degree of prostration.

Physical Examination.—He was a well-developed, but poorly nourished and anaemic, Honduranian laborer. A cauterized, incised wound was observed at the base of the left, fourth toe. There was moderate swelling of the left foot and ankle. The toe wound continued to bleed. *Spleen* was enlarged. *Heart, lungs, and abdomen* were negative. *Pulse rate* was 100, and the quality was good. *Temperature* was 99°.

Laboratory Reports.—*Blood*—negative for parasites; haemoglobin—55 per cent. *Urine*—Trace of albumin, and large amount of blood present. *Stools*—uncinaria, ascaris, and some cysts of *E. coli* found. *Wassermann and Kahn tests* negative.

Treatment.—One ampoule of anti-bothropic serum was given subcutaneously, at the time of admission. Tincture of digitalis, 20 minims, was given twice daily for 10 days.

Progress Notes.—The wound on the toe continued to bleed for 4 days. The swelling of the foot and ankle subsided after 1 week. The sixth day after admission he expectorated a small amount of blood and had a slight haemorrhage from the left nostril. The toe later became gangrenous, and had to be amputated on the eighth day after admission. Patient regained his strength slowly.

Result on Discharge.—Discharged April 10, 1926. Recovery, with loss of the left fourth toe.

CASE 2

Case History.—No. 6,408.

Admitted to hospital October 21, 1926, at noon, 4 hours after the accident.

History.—While cutting bush on Farm 24 in the Guaymas district, at about 8 a.m., October 21st, he was struck on the left leg by a snake, which he killed and brought in for identification. It was a specimen of the fer-de-lance, about 36 inches in length.

First Aid.—None. No ligature applied.

Symptoms.—He had severe pain as high as the mid-thigh region, and about 2 hours after the accident he began to vomit and to expectorate bloody saliva.

Physical Examination.—The patient was a well-nourished, well-developed Honduranian laborer. He had an anxious expression, and showed a moderate degree of prostration. There was a single puncture wound, 9 inches above the left external malleolus. Swelling and tenderness were noted in the left leg. He was vomiting and expectorating blood, which also oozed from the bite-wound and from the gums. *Chest and abdomen* were negative. *Pulse* was of low tension and had a rate of 60. *Temperature* was 98.6°.

Laboratory Notes.—*Blood*—negative for malaria, October 22nd. *Stools* negative. *Urine*—albumin, casts, and blood present. *Kahn test* negative.

Treatment.—The patient was given one ampoule of anti-bothropic serum, subcutaneously. Strychnine was given, $\frac{1}{30}$ of a grain every 4 hours for 4 days.

Progress Notes.—The expectoration of bloody saliva and the oozing from the bite-wound continued for 24 hours. The swelling of the leg and thigh persisted for 3 weeks, and there was some induration over the calf muscles, with tenderness and stiffness until the time of the patient's discharge. From the second until the seventh day he had an afternoon temperature of 100° to 101°F. The pulse was never over 100.

Result on Discharge.—Discharged December 11, 1926. Recovery, with some tenderness and stiffness of the left leg.

CASE 3

Case History.—No. 6,793.

Admitted to hospital December 3, 1926. Hour not stated.

History.—He was bitten by a snake on the dorsal aspect of the proximal phalanx of the right fourth finger at 9 a.m., December 3, 1926. The accident occurred in the Guaymas district. The snake, about 18 inches long, was identified as a young barba amarilla, or fer-de-lance. The patient discovered 2 pin-point fang punctures, about $\frac{3}{8}$ of an inch apart, and located in a transverse fashion across the finger.

⁷ Reprinted with permission from the 15th Annual Report of the Medical Department of the United Fruit Company, 1926.

First Aid.—Fifteen minutes after the accident he was treated in the Guaymas dispensary. The puncture wounds were incised and a dressing was applied—also a tight bandage above the wrist. The patient had previously attempted to “massage” the poison out, and then applied tobacco to the wound. Some herb that is supposed to be a cure for snake-bite was also used.

Symptoms.—Immediately following the snake-bite, he felt pain up to the shoulder. Very soon, he became nauseated and vomited.

Physical Examination.—The patient was a well-developed, well-nourished Salvadorian laborer. Right hand and forearm were swollen. No fang punctures were visible, because of the longitudinal incision that had been made on the dorsal surface of the right fourth finger over the proximal phalanx. The patient was not toxic in appearance, and did not feel sick at the time of the examination.

Preparation was made to administer anti-bothropic serum, but the staff considered that only local treatment was required and doubted that the wound had been caused by a fer-de-lance.

Laboratory Notes.—*Blood*—negative for malaria. *Kahn test* positive. *Stools*—positive for ascaris, uncinaria, and cysts of *E. coli*.

Treatment.—One ampoule of anti-bothropic serum was given, subcutaneously, at 7.30 p.m., December 4, 1926 (22.5 hours after the accident had occurred).

Progress Notes: December 4th, a.m. No pain or bleeding. Forearm swollen.

December 4th, 2.30 p.m. Complained of pain extending up to the shoulder. No increase in the swelling of the forearm.

December 4th, 7 p.m. Pain increased and the swelling of the forearm had advanced to the upper arm. *Temperature*, 99°F.; *pulse*, 88; no vomiting or bleeding, yet patient's general condition was worse.

December 5th (morning following the use of antivenin). There was no pain but some bleeding occurred at the snake-bite wound. The swelling of the arm was apparently decreasing. General condition was improved.

December 5th, p.m. Patient felt much better, and the swelling subsided rapidly. No pain.

December 6th. Numbness in all fingers of the hand. Very little swelling noted.

December 11th. The wound was healed. There was slight numbness in the fingers, but otherwise patient felt well.

Result on Discharge.—He was discharged December 11, 1926. Recovery, with slight numbness remaining in the fingers.

CASE 4

Case History.—No. 7,444.

Admitted February 10, 1927, immediately after the accident.

History.—The patient is the superintendent of the Tela serpentarium. He was bitten, about 10 a.m. on February 10, 1927, by a fer-de-lance 3½ feet long. It struck him on the left thumb, at the right base of the nail.

First Aid.—The wound was immediately sucked, and a shoe-lace was applied as a ligature about the base of the thumb. The patient at once started for the hospital and was met on his way by a hospital physician, who immediately injected subcutaneously an ampoule of anti-bothropic serum in the left scapular region. The wound was incised. Only one fang puncture was found.

Symptoms.—Within 2 minutes after the snake struck, the man became blind for a few minutes. He was pallid and had a pulse rate of 65, which dropped to 50 in half an hour; the volume also was poor. He complained of nausea and of pain in the entire arm, but especially in the thumb at the site of the shoe-lace tourniquet. A rubber catheter was applied below the shoe-lace, and the latter was then removed. An hour later a tourniquet was applied above the elbow, and the one on the thumb was removed. The tourniquet above the elbow was removed at the end of an hour's time. Forty minutes after the snake bite, the patient vomited and expectorated blood. This condition persisted for 24 hours, during which period also the wound bled freely. No haemorrhages were found in the skin.

Physical Examination.—The patient, an adult, white man, had a single fang puncture at the base of the left thumb nail, and the hand was moderately swollen.

Treatment.—One ampoule of anti-bothropic serum was given subcutaneously almost immediately after the man was struck. Stimulation was used for a few hours. The wound was sucked, incised, and dressed; a tourniquet was applied to the base of the thumb, and later above the elbow.

Progress Notes.—*February 11th*, his general condition was improved, but he felt weak and the hand was swollen. *February 12th*, patient weak; moderate swelling of the hand. *February 13th*, he visited dispensary; the hand was still swollen and there was necrosis about the wound at the base of the thumb nail. He stated that he had formerly been bitten by rattlesnakes, copperheads, and moccasins, but that the effects of those bites were not so severe nor so prompt in their manifestations.

Result on Discharge.—He was discharged, on his own request, February 12th. He will probably lose the nail; if so, it will be the fourth one that he has lost from the same cause.

12. THE DISTRIBUTION AND HABITS OF THE MASSASAUGA

By D. A. ATKINSON and M. GRAHAM NETTING

Carnegie Museum

The records for the occurrence of the Massasauga (*Sistrurus catenatus catenatus*) in New York have been listed by Moesel (1918) and Wright (1919), but records for Pennsylvania are very scarce in literature. Those given by Atkinson (1901, p. 153) are the only published records for Pennsylvania which we have found. In recent years many additional records have been collected, and we are publishing these in the hope that the public may become aware of the presence of a third venomous snake in this region, and in order to convince scientists that this species is by no means extinct in the eastern portion of its range.

The word "massasauga" is derived from two Chippewa Indian words which may be translated literally "great river-mouth." From this we infer, perhaps wrongly, that the Chippewas found this snake in the region of the river-mouths. In Chippewa country (Lake Superior region) the rivers formed swampy mouths rather than grassy outwash plains. From this we may assume that swamps were the natural habitat of this species in the northeastern portion of its range.

The Massasauga is known to farmers, in those regions where it is common, by a variety of common names. At Pymatuning Swamp this species is called, almost exclusively, the "Black Snapper." The only other common names that are used in this region are "Swamp Rattler" and "Pygmy Rattler." Further west the species is referred to variously as the "Black Massasauga," "Black Rattler," "Black Snapper," and "Prairie Rattlesnake."

Our records cover a period of sixty years although actual collecting has been carried on by the authors for only a portion of that time. We have records of thirty-five specimens, six of which are in the collection of the Carnegie Museum. Most of the following records are from the notebook of the senior author.

1866—Allegheny County.

Samuel F. Watson collected one specimen during the summer in a small swamp near Bakerstown. August 8, 1899, the dried skin of this specimen was examined and the swamp visited. Mr. Watson stated that a number

of specimens had been killed in the same region about 1866. During the intervening years the swamp had been largely drained, and in 1899 no specimens were found and none had been seen by local residents for some years.

September 2, 1899—Butler County.

D. A. Atkinson took two specimens in a small swamp along Muddy Creek near Butler. They were found under a rotten log at the edge of the swamp.

May 13, 1905—Butler County.

D. A. Atkinson and John L. Graf collected five specimens in and around a small swamp near Criders Corners. They were lying coiled in small grass hummocks, sunning themselves. Their skins were mud-stained and they appeared to have crawled out of the water. They were 18½, 23¼ (C. M. no. 1985), 26 (C. M. no. 1986), 32, and 36¼ inches in length.

July 11, 1905—Allegheny County.

D. A. Atkinson examined two specimens that had been killed by a farmer in a wheat field at Thorn Hill, about three miles from the swamp at Criders Corners. The larger specimen, a female 33 inches in length, contained seven well developed embryos. These embryos were four inches in length with fairly well developed skin markings. The smaller specimen was a male 22½ inches in length. The field in which these snakes were killed was about one hundred yards from low marshy ground and about four hundred years from Brush Creek. Mr. Douthett, a farmer living nearby, stated that he frequently killed Massasaugas on his farm.

May 17, 1906—Butler County.

D. A. Atkinson, G. A. Link, O. E. Jennings, and A. E. Ortmann collected six specimens at the swamp at Criders Corners. The vegetation was still low and the marsh marigold and the bluebells were in bloom. The six specimens measured 13 (C. M. no. 773), 17¾, 19, 28, 31, and 33½ inches in length. Three of them were found coiled up on hummocks in the swamp; the remaining three were found crawling around in the thicket near the swamp. Dr. Atkinson was bitten by the 31 inch specimen as described below: "He was under the end of a log and as I reached down to turn the log over he struck me on the back of the hand. A constricting band was placed at the elbow, the wound was cut deeply, and Mr. Link aided the flow of blood by suction. The wound was sharply painful until after bleeding was induced, but not markedly so afterwards. The hand remained swollen and partially disabled for four days, but there were no symptoms of general poisoning."

May 23, 1906—Butler County.

D. A. Atkinson took a small specimen, 11½ inches in

length, along Brush Creek, one mile east of the Criders Corners swamp. The snake was under a piece of bark on the bank of the creek.

June 10, 1906—Mercer County.

D. A. Atkinson examined a specimen that had been killed a few days previously at the edge of Half-moon Swamp near Hadley.

April 25, 1907—Butler County.

D. A. Atkinson caught a specimen at Criders Corners which was coiled on a grass hummock in the sun. The day was unusually warm for the season, 82 degrees in the shade, but the trees were still in bud. The specimen was 29½ inches in length, and its stomach was empty.

May 5, 1907—Butler County.

D. A. Atkinson took one specimen, 23½ inches in length, along Brush Creek.

April 26, 1908—Allegheny County.

D. A. Atkinson captured two specimens at Thorn Hill. They crawled out of a brush pile which he set on fire.

May 11, 1912—Butler County.

D. A. Atkinson and A. E. Ortmann collected three specimens in the swamp at Criders Corners. They measured 20½, 22, and 31 inches in length.

1915—Allegheny County.

G. A. Link collected one specimen (C. M. no. 2077) near Douthett Station. It measured 31½ inches in length.

May 14, 1916—Butler County.

D. A. Atkinson collected two specimens at Criders Corners. They had both shed recently and were brightly colored.

May 4, 1920—Butler County.

D. A. Atkinson, Chas. H. Schafer, Luther Spoehr, and Howard Dolde collected two specimens which were coiled on piles of dead grass in the sun at Criders Corners.

1920—Allegheny County.

O. E. Jennings recorded one specimen from the swamp near the Boys' Industrial Home.

May 8, 1922—Crawford County.

S. H. Williams and George M. Sutton saw one very small specimen coiled on a fern clump in Pymatuning Swamp near Hartstown.

June 14, 1922—Butler County.

D. A. Atkinson secured the rattles of two specimens which were killed by Samuel Jenkins at an oil well near Greece City.

April, 1926—Crawford County.

S. C. Quick killed a specimen (C. M. no. 4152) on a grassy hillock in Pymatuning Swamp near Hartstown. It was 31 inches long. The farmers living near Pymatuning Swamp reported numerous others killed in recent years. Dr. O. E. Jennings mentioned hearing the rattling of this species in the cinnamon fern region of the swamp.

The nine localities listed above cover only a small strip of territory in four counties. Criders Corners, Thorn Hill, Douthett Station, and the Boys' Industrial Home are all less than three miles apart, and are all in the Brush Creek drainage. Furthermore all of the localities given are included in the drainage of the Beaver River. Sears has studied (1926) the post-glacial vegetation of Ohio. His results indicate that a tongue of prairie extended from Ohio into Beaver County, Pennsylvania. We believe that the Massasaugas pushed northward and eastward, and followed this strip of prairie into western Pennsylvania. From the Beaver River they spread gradually into the marshes along the water courses. Timber succeeded the prairie and the snakes were cut off in the swamps and bogs which they still occupy. Northward other individuals probably spread along the grassy regions border-



FIG. 8. The Massasauga rattlesnake, *Sistrurus catenatus*. By permission of the New York Zoölogical Society.

ing the Great Lakes and worked into Ontario and western New York. We do not believe that the Massasauga ever spread east of the Allegheny River in Pennsylvania or south of the Ohio River in Pennsylvania or Ohio. The western New York records seem to belong to the northward movement along the southern shores of Lake Erie and Lake Ontario. If specimens should be found in Erie County, Pennsylvania, where they likely occurred formerly, they should be considered part of this same invasion. Near Erie, Pennsylvania there is a point called "Massasauga Point" which may have been so named because of the presence of these snakes. Portions of Beaver, Allegheny, Butler, Lawrence, Mercer, and Crawford Counties were probably populated by the invasion from central Ohio. The species still occurs in the swamps of at least four of the above counties.

Of the six specimens in the Carnegie Museum

collection five have the scales in twenty-five rows; one, no. 4152, has twenty-three rows of scales. The number of ventrals ranges from 136 to 142, and the number of subcaudals from 22 to 28. None of the specimens examined by us were referable to the black phase, yet all of these specimens were darker than specimens from Indiana. Some were quite dark dorsally but in all cases the markings were plainly visible. The nineteen specimens of which we have the measurements ranged from 13 to $36\frac{3}{4}$ inches in length. The average length, 26.3 inches, is scarcely of any value for many of the specimens were obviously immature. It is significant, however, that eight specimens were over thirty inches in length. Adults of this species may be considered as large as the Copperhead (*Agkistrodon mokasen*).

Seventy-five per cent of the individuals listed above were collected during the months of April and May. On warm sunny afternoons during those months, before the cinnamon fern has grown shoulder-high in the swamps, specimens are easily secured. Later in the summer the same region may be carefully searched without securing a single specimen. Either the luxuriant plant growth hides the snakes much better during the summer or they desert the swamps and go into the surrounding fields. The latter supposition seems to us to be the most probable. Gebhard says (1853, p. 22): "During the summer season, they leave the swamp, and go into the adjoining fields of grain, where they remain until fall, when they return to the swamp and hibernate." This statement is supported by the testimony of the farmers near Pymatuning Swamp. They agreed in stating that they found the snakes quite generally along fence rows and under planks about the edges of their fields during the summer months, but that in the spring they found the Massasaugas in the swamp itself. Furthermore the two specimens which were secured during July were taken in a wheat field. It seems probable that the snakes mate in the swamps, and then move into higher ground during the summer.

Such a change in habitat must necessarily indicate a seasonal variation in the food preferences of this species. That individuals vary greatly in feeding habits in captivity we know from our own experience and from the published accounts of other writers. Taylor reported (1892, p. 752) that captive specimens refused food, and that the stomach contents of specimens

which were examined consisted almost wholly of rodents. A specimen which was kept for nine months in the Museum laboratory took no food although offered mice, frogs, and toads. Hay reported (1887, p. 216) that two females fasted from August 1 until January 28. The five specimens collected by Graf and Atkinson, May 13, 1905, were kept alive for several weeks. Two of them ate half-grown Leopard Frogs (*Rana pipiens*) readily. The other three refused to eat although they were kept in the same cage. The snakes did not strike the frogs, but swallowed them alive in much the fashion of a garter snake. The female collected July 11, 1905, had a partially-digested Field Mouse (*Microtus pennsylvanicus*) in its stomach, and the male of the same date had two Spring Peepers (*Hyla crucifer*) in its stomach. One of the specimens taken May 17, 1906, ate four mice while in captivity. It struck them and waited until they died before swallowing them. We are aware that the feeding habits of this species correspond to the feeding habits of the Copperhead, but we have not found any evidence to show that the Massasauga ever takes insect-food as the Copperhead does. Surface's statement (1906, p. 101) that this species should be expected to feed on "insects, particularly grasshoppers" was based, in part, on the erroneous idea that the Massasauga lived mostly in grassy fields. As we have shown, the snakes in this region visit the fields only during the summer, and their food at that time is likely confined to rodents, small birds, and the frogs that they may secure when near water.

The period of gestation in this species is probably about three months. Two females (C. M. nos. 1985, 1986) which were taken on May 13, 1905 contained eight and nine eggs, respectively. The embryos in these eggs were visible as tiny coiled snakes. The female taken on July 11, 1905, contained seven four inch embryos. Hay mentions (1887, p. 216) two females giving birth to five and six young about September 1. The young were from three to four inches long at birth. The young contained in the July 11 female would surely have been born in another week. Thus we judge that in western Pennsylvania mating takes place late in April or early in May, and that from five to nine young are produced late in July or early in August.

In conclusion we might say that the Massasauga reaches approximately the same size as the Copperhead, that it still occurs in the swamps of

western Pennsylvania, and that its bite, while scarcely fatal, deserves the same careful treat-

ment that would be given in any other case of snake-bite.

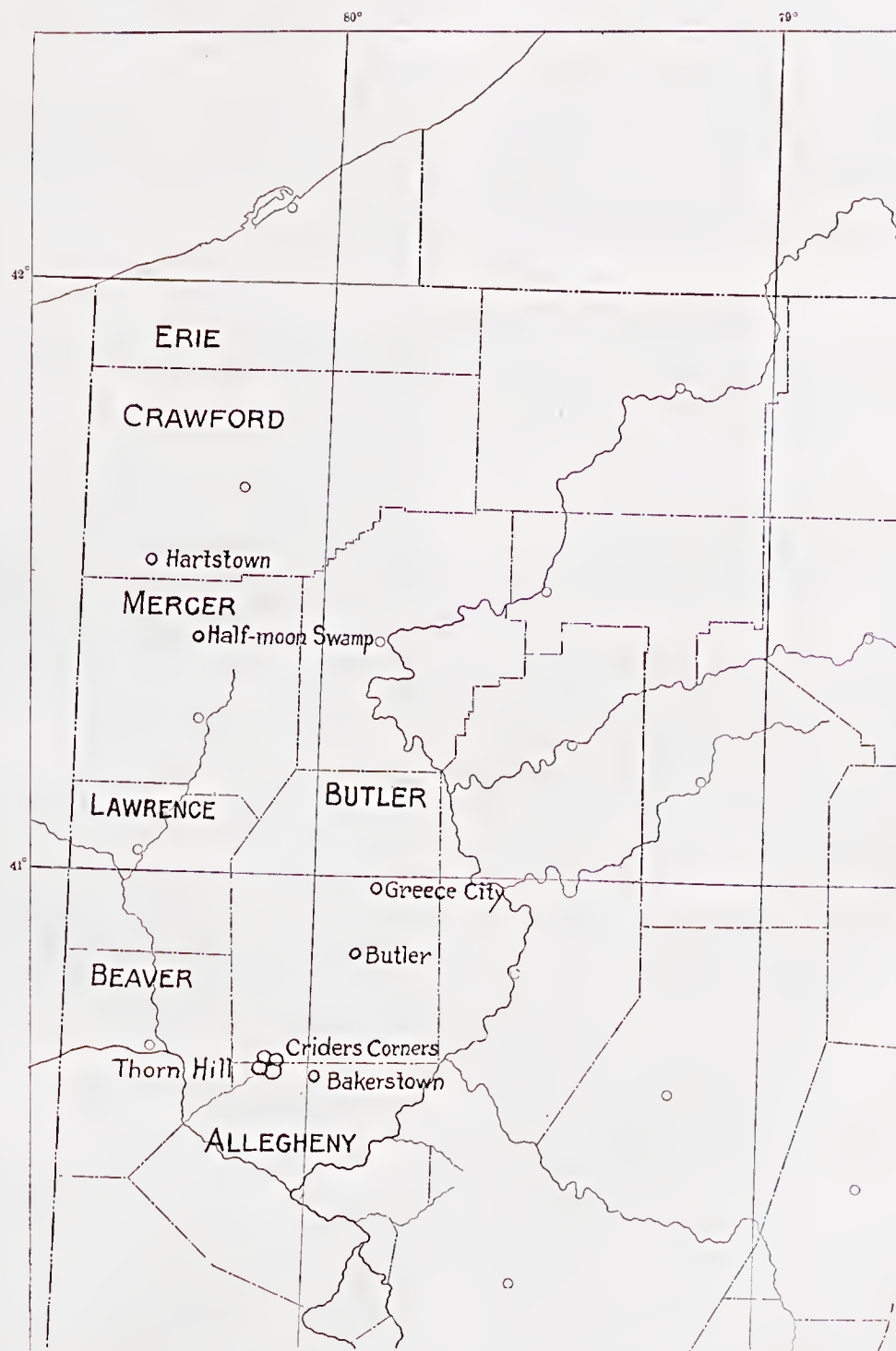


FIG. 9. Map of northwestern Pennsylvania, showing locality records of *Sistrurus calenatus*.

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13. STUDIES OF NEOTROPICAL OPHIDIA

VII. AN INTERESTING COLLECTION OF SNAKES FROM WEST COLOMBIA

By AFRANIO DO AMARAL

I have recently received from Dr. L. Stejneger, of the United States National Museum, for identification, a small collection of snakes made by Mr. E. J. Pampana, in the region of the San Juan River, Provincia Choco, in the western part of Colombia.

On close examination, the collection has proved to be so interesting that I have decided to publish the following notes with a view to pointing out a few features that seem quite important, as they bring out some new facts on the Neotropic ophiologic fauna.

The present collection is noteworthy because of the following points:

1. It consists of 20 specimens representing 19 species, 6 of which are venomous (4 solenoglyph and 2 proteroglyph).

2. Among the solenoglyph specimens 3 are tree vipers, namely, *Bothrops brachystoma*, *B. schlegelii* and *B. leptura*.

3. It includes a specimen of *Trachyboa boulengeri*, which has hitherto been known only from the type, described in 1910 by Peracca, without locality. The occurrence of this horned snake in West Colombia is rather puzzling, as it comes from a humid and woody district, so that it constitutes one more exception to the rule that horned ophidia are representatives of arid or desert places. As Barbour⁸ has recently pointed out, desert species are especially prone to show horns, which are prominent, for instance, in the Western desert rattlesnake called "Sidewinder."

However, they are seen, too, in Schlegel's viper of the moist jungle of Central America.

Klauber, in a recent paper⁹ considered the supraocular horns as serving not only as partial shade for the eyes from the intense glare and heat of the desert sun but as a protection against the drifting sand. This explanation, of course, is not applicable to the case of *Bothrops schlegelii* or *Trachyboa boulengeri*, both of which live in shaded, moist places of the American tropics.

4. There is included one specimen of *Erythrolamprus aesculapii*, var. *monozona* Wied., which seems to be very rare, except perhaps in North-eastern Brazil.

5. A specimen of a *Micrurus ancoralis* is also represented and its symphyseal is separated from the chin-shields by the first pair of lower labials.

6. Finally, it includes a specimen of *Sibynomorphus leucomelas*, which is a very uncommon species indeed.

Fam. BOIDAE, sub-fam. BOINAE.

Gen. EPICRATES Wagler

type: *cenchris**Epicrates cenchris* (L.)*Boa cenchris* Linnaeus, Syst. Nat., 1: 215. 1758.*Epicrates cenchris* Wagler, Syst. Amph.: 168. 1830.*Epicrates cenchris* Boulenger, Cat. Sn. Brit. Mus. 1: 95. 1893.

No. 72,361, yg., ♀. 13 upper labials (6ths and 7th entering orbit); loreal touching the 2d labial but separate from the 3rd, 4th and 5th labials by scales; 3/4 postoculars. Sc. 49. V. 236. A. 1. C. 52.

⁸ T. Barbour, Reptiles and Amphibians; 92, 1926.⁹ L. M. Klauber—Bull. Antiv. Inst. of Am., I, 1: 20, 1927.

Gen. TRACHYBOA Peters
type: *gularis*
Trachyboa boulengeri Peracca

Trachyboa boulengeri Peracca, Annuar. Mus. Zool. Univ. Napoli. 3: 12. 1910.

No. 72,354, yg., ♂. Sc. 33. V. 132. A. 1. C. 21 + 1/1.

Colouration: chocolate brown above with irregular yellowish blotches on the middle of dorsum, with 5 series of black spots, 2 on each side and one on the vertebral line; head dark brown, lips, yellow and brown anteriorly, brown posteriorly; under surface light yellowish pink, with 2 series of large black spots or cross-bands irregularly disposed; tail light brown with black dots above, yellowish nearly immaculate below.

Note: The present specimen has 19 maxillary teeth very slightly enlarged anteriorly; 7 palatine, 16 pterygoid and 21 mandibulary teeth. Total length 190 mm.; tail 19 mm.

Fam. COLUBRIDAE; sub-fam. a) COLUBRINAE
Gen. DRYMOBIUS Fitzinger
type: *margaritiferus*
Drymobius rhombifer (Günther)

Coryphodon rhombifer Günther, Pr. Zool. Soc.: 236. 1860.

Drymobius rhombifer Boulenger, Cat. Sn. Brit. Mus. II: 14. 1894.

No. 72,367, ♂. Rather rare species. T. 2 + $\frac{1}{2}$ + 2. V. 153; tail injured.

Gen. SPILOTES Wagler
type: *pullatus*
Spilotes pullatus (L.)

Coluber pullatus Linnaeus, Syst. Nat., 1: 225. 1758.

Spilotes pullatus Amaral. Proc. U. S. N. M. 67. Art. 24: 3. 1925.

No. 72,369, yg., ♂. Internasals slightly broader than long. 8 labials (4th and 5th entering orbit); 1 small loreal; posterior chin-shields separated from each other by small scales. Sc. 14 (18-15-13-14-12-10), rather large. V. 216. A. C. 125.—Black above with few yellow spots anteriorly; posteriorly all black above and below; belly yellow anteriorly with black transverse bands.

Common name: "Mica."

Gen. CHIRONIUS Fitzinger
type: *carinatus*
Chironius carinatus (L.)

Coluber carinatus Linnaeus, Syst. Nat., 1: 223. 1758.

Heliodryas carinatus Boulenger, Cat. Sn. Brit. Mus. II: 73. 1894.

Chironius carinatus Ruthven, Misc. Publ. Univ. Mich. Mus. Zool. 8: 65. 1922.

No. 72,362, yg., ♀. 9 Labials (5th and 6th entering orbit). T. 1 + 2. V. 160. A. 2. C. 123.

Colour olive above, with whitish spots and scales light centered, black edged, especially on paraventral rows so as to form 1 longitudinal light interrupted line on each side of posterior part of body and tail; greyish beneath, all like var. B of Boulenger.

Gen. LEPTOPHIS Wagler
type: *ahaetulla*
Leptophis bilineatus (Gthr.)

Diploptropis bilineatus Günther, Ann. Mag. N. H. (4). 9: 24, pl. VI, fig. B. 1872.

Leptophis bilineatus Boulenger, Cat. Sn. Brit. Mus. II: III. 1894.

No. 72,350, ♀. Loreal twice as long as deep. 9 Labials (5th and 6th entering orbit). 15 sc. smooth but one on each side of vertebral row distinctly keeled. V. 157, angulate laterally. A. 2. C. 162 p.

Dark blue (in alcohol + formalin), lighter beneath, 2 darker lines following the dorsal keels; lips and throat yellowish-gray.

I am identifying this snake with *L. bilineatus* only tentatively, because I am quite inclined to consider this name as well as *L. diploptropis*, *L. saturatus*, and perhaps also *L. cupreus* and *L. modestus* as being merely synonymous with *L. mexicanus*. Indeed, the whole genus *Leptophis* is very much in need of a thorough revision.

Gen. OPHIS Wagler
type: *merremii* (by original designation)
Ophis colubrinus (Gthr.)

Xenodon colubrinus Günther, Cat. Col. Sn.: 55. 1858.

Xenodon colubrinus Boulenger, Cat. Sn. Brit. Mus. II: 146. 1894.

No. 72,357, yg., ♀. 8 Labials (4th and 5th entering orbit). Postocular 3/2. T. 1 + 2/1 + 3. Sc. 19. V. 157. C. 49 p.

Head black above with a Ω -like light marking originating from the praefrontals and running through supraocular and temporals to beyond corner of mouth as well as to sides of neck and belly where both branches meet; this marking separates the nucho-occipital dark marking from the black post-ocular streak; a small Y-like light marking between the parietals.

Gen. LYGOPHIS Fitzinger
type: *lineatus*
Lygophis taeniurus (Tschudi)

Liophis taeniurus Tschudi, Fauna Peruv. Herp. 51. pl. 5. 1845.

Liophis taeniurus + *L. albiventris* Boulenger, Ann. Mag. N. H. (8) 1: 115. 1908.

Aporophis taeniurus Boulenger, Ann. Mag. Nat. Hist. (8) 1: 115. 1908.

Number	Sex	Sc.	Apical pits	V.	C.	Postoc.	Lat. stripe	Belly	Colour above
72364	♀	17	1	144	69 p.	2	Present	Yellow slightly powdered with brown	Brownish olive and black lateral spots
72368	♀	17	1	140	63 p.	2	Present	Yellow	Brownish olive and black lateral spots

Sub-fam. b) DIPSADINAE
Gen. *SIBYNOMORPHUS* Fitzinger
type: *mikanii*
Sibynomorphus leucomelas (Boulenger)

Leptognathus leucomelas Boulenger, Cat. Sn. Brit. Mus. III: 453. pl. 24, fig. 1. 1896.
No. 72,356, ♂. 7 Labials (4th and 5th entering orbit). V. 194. C. 103. Total length 670 mm.; tail 185 mm. Colouration as described by Boulenger.

Sub-fam. c) BOIGINAE
Gen. *IMANTODES* Dm. & Bibr.
type: *cenchoa*
Imantodes cenchoa (L.)

Coluber cenchoa Linnaeus, Syst. Nat., I: 226. 1758.
Imantodes cenchoa, Duméril & Bibron, Erp. Gén. I: 1065. 1854.
Imantodes cenchoa Boulenger, Cat. Sn. Brit. Mus. III: 84. 1896.
No. 72,358, ♂. Preocular 1, Postoculars 2. Temp. 2 + 3. V. 260. C. 141. 61 dark brown spots on back, extending down to ventrals.

Gen. *LEPTODEIRA* Fitzinger
type: *annulata*
Leptodeira annulata (L.)

Coluber annulatus Linnaeus, Syst. Nat. I: 224. 1758.
Leptodira annulata + *L. albofusca* Boulenger, Cat. Sn. Brit. Mus. III: 27 and 25. 1896.
Leptodeira annulata Griffin, Mem. Carnegie Mus. XI: 321. 1917.
Leptodeira annulata Barbour & Amaral, Bull. Antiv. Inst. Am. I. 1: 25. 1927.
No. 72,351, ♂. Preocular 1. 8 Labials (3rd, 4th and 5th entering orbit). Sc. 21, vertebral very slightly enlarged. V. 193. C. 96 p.
Small lateral brown spots present besides the large dorsal ones. Common name in Colombia: "Mapaná."

Gen. *PSEUDOBOWA* Schneider
type: *coronata*
Pseudoboa petola (L.)

Coluber petola Linnaeus, Syst. Nat. I: 225. 1758.
Coluber petolarius Linnaeus, Syst. Nat. I: 225. 1758.
Oxyrhopus petolarius Boulenger, Cat. Sn. Brit. Mus. III: 101. 1896.
Pseudoboa petola Amaral, Rev. Mus. Paulista XII: 10. 1926.
No. 72,363, ♂. Preocular forming suture with frontal. 9 Labials (5th and 6th entering orbit)/8 (4th and 5th entering orbit). Sc. 20 or 19 (when 19, the vertebral slightly enlarged). V. 210. C. 109 p.

Head shields black, except temporals and posterior labials; nape yellow; 32 wide black cross-bars, sometimes broken in vertebral line and forming zig-zags, on dorsum; subcaudals dark brown, light-edged.

Note: Many specimens of this and other species of same genus show a remarkable tendency to have enlarged vertebral scales.

Gen. *ERYTHROLAMPRUS* Dm. & Bibr.
type: *agilis* = *aesculapii*
Erythrolamprus aesculapii (L.)

Coluber aesculapii Linnaeus, Syst. Nat. I: 220. 1758.
Erythrolamprus aesculapii, Duméril & Bibron, Erp. Gén. VII: 875. 1854; and Boulenger Cat. Sn. Brit. Mus. III: 200. 1896.
No. 72,353, ♂. V. 180. C. 47 p. Red above with 14 black single light-edged annuli showing a tendency to be subdivided posteriorly, complete or broken on vertebral and median ventral lines and then alternately distributed. Head with 2 black bands, one across the snout and eyes, the second across the occiput (var. *monozona* of Boulenger). Common name "Serpiente coral."

Sub-fam. e) ELAPINAE
Gen. *MICRURUS* Wagler
type: *spixii*
Micrurus mipartitus (Dm. & Bibr.)

Elaps mipartitus Duméril & Bibron, Erp. Gén. VII: 1220. 1854.
Elaps mipartitus Boulenger, Cat. Sn. Brit. Mus. III: 431. 1896.
Elaps fraseri Boulenger, Cat. Sn. Brit. Mus. III: 432. pl. 22, fig. 3. 1896.
Elaps mentalis Boulenger, Cat. Sn. Brit. Mus. III: 432. pl. 22, fig. 4. 1896.
Elaps microps Boulenger, Proc. Zool. Soc.: 1036. pl. 108, fig. 2. 1913.
Micrurus mipartitus (redescription) Amaral, Proc. N. E. Zool. Club. 9: 66. 1926.
No. 72,366, ♀. Eye diameter less than 1/2 as long as its distance from mouth. V. 263. C. 24 p. Black with 56 light (red in life) crossbars or rings widening toward the belly which is whitish (reddish in life) barred with black; 2 wide light + 2 black bars on tail.

Note: In my redescription of *M. mipartitus* as appeared in Proc. N. E. Z. Club. 9: 66. 1926 the colouration was given as being "black above, with 38-84 (males 40-76; females 38-84) black annuli, etc." This was, of course, due to a slip in reading over the proof, as the colour is "black above with red (light in alcohol) annuli, etc."

Common name in Central America "Gargantilla" (necklace), given on account of the regularity of its dorsal rings or annuli.

Micrurus ancoralis (Jan)

Elaps maregravi, var. *ancoralis* Jan, Icon. Gén. 42. pl. IV, fig. 2. 1872.
Elaps ancoralis Boulenger, Cat. Sn. Brit. Mus. II: 432. 1896.
No. 72,365, ♂. T. 1 + 2. Symphysial separated from chin-shields by first pair of lower labials. V. 256 + 1/2 + 1/2. C. 36 p. Body red with 15 sets of black rings, the middle one a little wider, scales of interspaces black, light-edged, head light in front, spotted with black around and between eyes; an anchor-shaped black marking on occiput and nape, the transverse branch nearly covering the parietals and as the longitudinal branch, extending down across the throat. Total length 800 mm.; tail 63 mm.

Note: The separation of the symphyisial from the chin-shields in this specimen corroborates my previous finding (in Proc. U. S. N. M. 67. art. 24: 19. 1925) in which the symphyisial was not touching the chin-shields. It also corroborates the statement I made in Proc. N. E. Zool. Club. 9: 64. 1926 in regard to the lack of significance of the relative closeness between symphyisial and mentals.

Fam. CROTALIDAE
Gen. BOTHROPS Wagler
type: *atrox*
Bothrops atrox (L.)

Coluber atrox Linnaeus, Syst. Nat., I: 222. 1758.

Coluber lanceolatus Lacépède, Serp. II: 80, 121. pl. 5, fig. 1. 1789.

Lachesis atrox + *Lachesis lanceolatus* Boulenger, Cat. Sn. Brit. Mus. III: 537 & 535. 1896.

Bothrops atrox (redescription) Amaral, Contrib. Harvard Inst. Trop. Biol. & Med. II: 41. 1925.

No. 72,359, yg., ♀. 7 Labials (2nd entering lorus). Sc. 27, keel high and short. V. 189. C. 60 p. + 3.

Colour as described in the Harvard Monograph (pp. 30-31). Common names in Panama and Colombia: "Taya," "Boca real," "Echis" (on account of the X markings across the dorsum), "Taya-Echis," "Barba amarilla," "Mata-caballo."

Bothrops brachystoma (Cope)

Teleuraspis castelnaui, var. *brachystoma* Cope, Proc. Ac. Sc. Phila.: 339. 1859.

Lachesis brachystoma Boulenger, Cat. Sn. Brit. Mus. III: 547. 1896.

Bothrops brachystoma Amaral, Bull. Antiv. Inst. Am. I. 1: 22. 1927.

No. 72,352, ♀. Rostral 2 × 1 (high and wide). Supraocular outer border surface-like. 3 series of scales between eye and labials. Sc. 23. V. 140. C. 30.

This snake, although of small proportions, is responsible for a great many bites and quite a few deaths, because of its habit of living on bushes, being very vicious and secreting a very active venom. The bites are usually inflicted on one's hands or fore-arms. It feeds on lizards.

Bothrops leptura Amaral

Bothrops leptura Amaral, Proc. N. E. Zool. Club. 8: 102. 1923 and

Bothrops leptura Amaral, Proc. U. S. N. M. 67: 29. 1925. Type from Cana (Santa Cruz de Cana), E. Panama.

No. 72,355, ♀. 7 Labials (2nd entering lorus), 2 well-developed and contiguous internasals, 2 large canthals. 1 row of scales between eye and subocular. Sc. 25. V. 198. C. 85 p. + 3. Tail prehensile, long and slender. Colour as described in Proc. Zool. Club (p. 103).

This is the 4th specimen I have examined of this snake, the formula for the four being the following:
Sc. 25-28

V. 198-202. C. 82-88. *B. leptura* seems to be very poisonous as its fangs occupy half or more of the length of the mouth and its venom glands are quite long and thick.

Bothrops schlegelii (Berthold)

Trigonocephalus schlegelii Berthold, Abh. Geschl. Wissen. Göttingen. III: 13. pl. I, figs. 5 & 6. 1846.

Lachesis schlegelii Boulenger, Cat. Sn. Brit. Mus. III: 567. 1896.

Bothrops schlegelii Amaral, 15th Ann. Rep. Med. Dept. United Fruit Co. 1926.

No. 72,360, ♀. 2 horn-like scales between eye and supraocular; 8 labials (2nd entering lorus). Sc. 23. V. 147. C. 52; tail prehensile. Grey above with 1 series of small light transverse spots on each side; yellowish beneath speckled with brownish grey.

Boulenger's description is very incomplete as to the colour, because I have seen specimens that are all greenish-grey, others are brownish or pinkish or light yellow or even whitish. The common name of this snake in Central America is "Serpiente de Pestana" or "Toboba de pestana." The greenish specimens are called "Bocaracá," the yellow "Oropel." This snake, together with *B. brachystoma*, is one of the most dreaded vipers in the Central American moist jungle, because it lives in bushes and gives no warning before striking. The bites are usually inflicted on one's hand or fore-arms and cause hemolysis, histolysis and paralysis. It feeds on lizards and perhaps small birds.

14. STUDIES OF NEARCTIC OPHIDIA

I. *CROTALUS GOLDMANI* SCHMIDT, 1922, A SYNONYM OF *C. MITCHELLI* COPE, 1861

By AFRANIO DO AMARAL

In 1922, K. P. Schmidt (1) described the species *Crotalus goldmani* based on one specimen collected at El Piñon, Lower California and which he considered to be different from *C. mitchellii* (Cope, 1861) on the following grounds: 1. in being dark reddish-brown with dark markings more nearly rhombic and with light centers; 2. in having narrower and more convex dorsal

scales; 3. in its supraoculars being broken up in two or three small scales.

Schmidt, however, seemed not to be very sure of the validity of the new species as he stated: "In view of the known variability of the scutellation of *C. mitchellii*, the present specimen may prove to be a nearly abnormal one of that species. The true status of *C. goldmani* espe-

cially remains to be cleared up, and in naming it, I hope I have emphasized the fact that it presents a problem for investigation."

To me the status of *C. goldmani* did not appear very clear either, because this species was considered valid by Stejneger and Barbour and so was included in the Second Edition of their Check-list (2). Blanchard failed to follow them, as in the preface of his monograph he stated that he did not see anything in *Crotalus goldmani* but a synonym of *C. mitchellii* (3).

Therefore, it was obvious that the former species needed to be reviewed, and last April, thanks to Dr. L. Stejneger's kindness, I had an opportunity to examine the type of that species in the United States National Museum. The type of *C. goldmani*, No. 37,573 in the U. S. N. M. collection, is a male having 18/19 labials, a scale formula 23-27-21, ventrals 180, caudals 25, as found by Schmidt, and therefore not different from *C. mitchellii* in this respect.

In regard to the colouration, it seems not to be different from the few live or preserved specimens of the latter species, which I have recently examined. At the same time, Klauber has of late pointed out (4) that the bleached rattlesnake exhibits a wide variety of colouration from buff and pink to grey, brown, red and black and white, the dorsal blotches usually not being definitely outlined, as they vary from hexagons through to indented rectangles.

The relative narrowness and convexity of the dorsal scales of *goldmani* are in no way different

from what may be found in a few specimens of *mitchellii*.

The sub-division of the supraocular into two or three small scales also seems not to have a specific significance, as it may also occur in specimens of *mitchellii*, or even of other species, such as *oreganus* and *confluentus*. In the collection of the United States National Museum, there are a few specimens of *mitchellii*, the supraoculars of which are more or less completely sub-divided. These specimens are:

- No. 22,048, adult, from Colorado River, California.
- No. 16,353, adult, from Colorado desert, California.
- No. 16,501, half-grown, from Colorado desert, California.
- No. 15,978, adult, from Puerto Refugio, Angel de la Guarda Island, Gulf of California.
- No. 8562, adult, from same Island as No. 15,978.

This sub-division of the supraocular appears to take place, in part at least, during the ontogenetic evolution, as young specimens for the most show a superficial shrinking of that shield, which seems to become more and more pronounced as the snake becomes older.

Having come to the conclusion that *goldmani* was probably untenable, I wrote to Dr. K. P. Schmidt, to whom I communicated my views and in his reply he stated that the supraocular character might appear elsewhere in the range of *mitchellii*.

In conclusion, I deem it advisable to consider *Crotalus goldmani* a mere synonym of *C. mitchellii*.

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15. STUDIES OF NEARCTIC OPHIDIA

II. *CROTALUS PRICEI* VAN DENBURGH, 1896, A SYNONYM OF *C. TRISERIATUS* (WAGLER, 1830)

By AFRANIO DO AMARAL

HISTORICAL

Wagler (1), in 1830, briefly described the species *tirseriatus* under the generic name of *Uropsophus*, based on Wiegmann's specimen which was received from Mexico and contained in the Berlin Museum.

Jan (2), in 1859, described *Crotalus lugubris* from Mexico, its types having 2 enlarged internasals and the following formula: $\frac{L. 12-14, Sc. 23-25}{V. 137-154, C. 21-32}$. As defined in both Rev. & Mag. Zool.: 156 and in Prodr. Icon. Descript. Ophid.: 31, *C. lugubris*

is now recognized as a composite of Wagler's *triseriatus* and Cope's *polystictus*. *C. lugubris* is figured in pl. E of the latter publication.

Fischer (3), in 1882, figured *Crotalus intermedius* from Mexico previously described in 1865 by Troschel (4). The type had two internasals in one row, 2 canthals plus 1 intercanthal in another row, and the formula: $\frac{\text{Lab. 10/9, Sc. 21}}{\text{V. 158, C. 31}}$; it was represented with 1 vertebral series of rather large sub-round spots.

Cope (5), in 1866, referred to *Caudisona triseriata* from Mexico as having 23 scale rows, 2 pairs of large scales on top of snout and 1 dorsal series of sub-round brown spots. Again in 1885 (6) and 1892 (7) he made reference to this species. Dugès (8), in 1876, applied Jan's specific name *lugubris* to a rattlesnake found in Guanajuato, Mexico.

Günther (9), in 1895, made reference to

name of *Crotalus triseriatus* (Wagler, 1830) as follows:

"Canthus rostralis distinct. Rostral as deep as broad, well visible from above, in contact with the anterior nasals and a pair of internasals; internasal separated from the supraocular by a large shield; one to five small smooth shields on the middle of the snout; supraoculars as broad as the space between them, which is occupied by three to five longitudinal series of scales; one or two series of scales between the eye and the labials; 9 to 13 upper labials. Scales in 21 to 25 rows, dorsals strongly keeled. Ventrals 142-184; anal entire; subcaudals 22-30. Olive or brown above, with a vertebral series of rather small dark brown spots with a fine black-and-light edge; sides with two or three series of smaller spots; upper surface of head with or without small dark spots; a dark light-edged band from the eye to the angle of the mouth or beyond; yellowish beneath, spotted or speckled with dark brown, or dark grey-brown powdered with whitish. Spec. *c* pale brown above, with mere traces of darker markings, yellowish beneath.

Total length 530 mm.; tail 55.
Mexico."



Fig. 10. *Crotalus triseriatus*, photograph of M. C. Z. specimen No. 22928, from Alvarez, San Luis Potosi, Mexico

Wagler's *C. triseriatus* as found in Guanajuato, Toluca, Zacualtipan, Jalapa and Orizaba in Mexico and described and figured two new species also from Mexico, namely, *Crotalus omiltemanus* (2 specimens) and *Crot. pallidus* (1 specimen), the former having been collected in Omilteme, Guerrero and the latter in the City of Mexico. *C. omiltemanus* was figured as having 2 internasals, 2 canthals, 2 intercanthals plus 1 small intermediate scale, and was found to have 9 labials separated from orbit by 1 row of scales, 21 dorsal scales and 178-185 ventrals. In the figure of *C. pallidus*, there were represented 2 internasals, 2 canthals plus 4 small intercanthals; 12-13 labials, separated from orbit by 2 rows of scales, Sc. 25 and V. 149.

Boulenger (10), in 1896, did a very wise thing when he considered all of the above species as synonymous and thus redescribed them under the

Boulenger's series was given as composed of 8 specimens all from Mexico and distributed by the following localities: La Cumbre de los Arrastrados, Jalisco (1 specimen), La Laguna, Juana-catlan, Jalisco (1 specimen), City of Mexico (1 sp., *c*, type of Günther's *C. pallidus*), Orizaba, Vera Cruz (1 specimen), Omilteme, Guerrero (2 specimens, both types of Günther's *C. omiltemanus*) and 2 more specimens from unknown localities.

Van Denburgh (11), in 1895, described *Crotalus pricei* as a new species, type from Huachuca Mts., Arizona, United States, and, in 1896 (12), figured it as having 6 dorsal series of blotches two along the vertebral line, larger, and 2 on each side, smaller. According to Van Denburgh, *Crotalus pricei* "seems to be most closely related to *Crotalus intermedius* Fisch. and *C. omiltemanus* Günth., but it may be readily recog-

nized by its very distinct coloration. From *C. omillemanus* it differs also in its smaller number of gastroteges, and from *C. intermedius* in its fewer urosteges." Since that date *C. pricei* has been accepted as valid by Cope (13), Brown (14) Stejneger (15), Ditmars (16), Stone (17) and Vorhies (18) and thus included in Stejneger and Barbour's Check List of North American Amphibians and Reptiles (1st edition, 1917, p. 110; 2nd edition, 1923, p. 125) and still more recently in Blanchard's—Key to the Snakes of the United States, Canada and Lower California (1925, p. 50).

Again in 1922, Van Denburgh, in his monumental work on Reptiles of the West (19),

first and from two to nine posterior usually divided. Rattle very slender and delicate.

"The general ground color is olive gray so thickly covered with minute brown dots as to give a decidedly brownish hue. A narrow dark brown band of uniform width runs back and down from the eye, just touching the upper angles of the eighth and ninth labials without involving them. The scales below this band are vinaceous cream. There are two small seal brown spots on the occiput. The genials and gulars are yellow, tinged with vinaceous laterally. The rest of the head is unicolor. Along each side of the back is a series of from 54 to 60 small brown blotches. Anteriorly these have a tendency to alternate, but posteriorly they unite with one another to form cross-bars. There are seven similar brown bars on the tail. The dorsal blotches are seal brown, palest centrally, and are edged with very pale brown or white. They are about one and one-half scales long, and from two

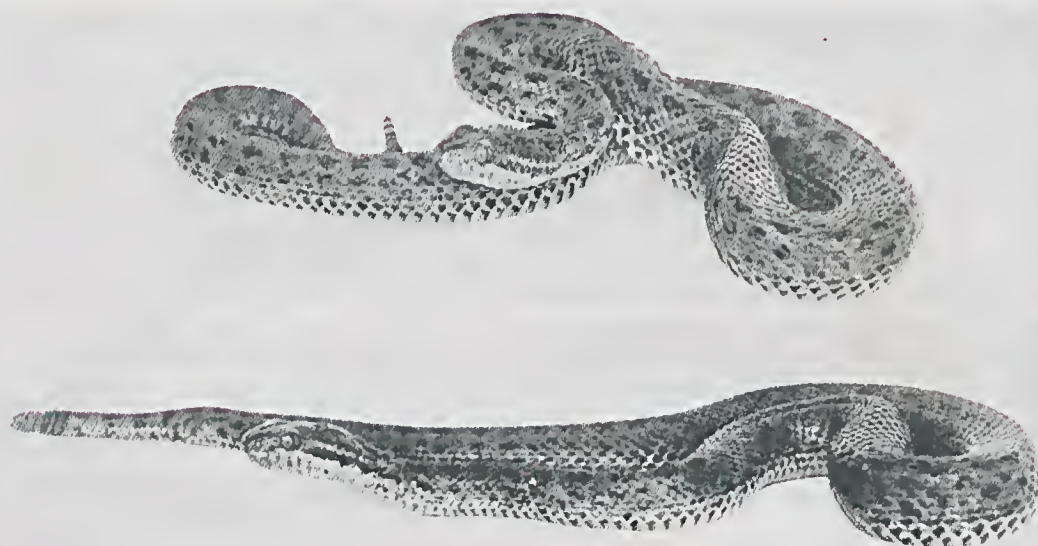


Fig. 11. *Crotalus pricei*, copied with permission, from plate 119 of Van Denburgh's "Reptiles of Western North America." (Type Specimen in Museum of the California Academy of Science, from Huachuca Mountains, Cochise Co., Arizona.)

published by the California Academy of Sciences, represented this species and redescribed it in more detail as follows:

"Size small. Head subtriangular, with flattened top. Rostral nearly as broad as high, in contact with anterior nasal plate. Two nasals. Two preoculars. Usually one loreal, sometimes two. Internasals proportionally rather large. A large scale just in front of supraocular. Supraocular large but not raised into a horn-like process, separated from its fellow by from one to three scales, Superior labials nine to 11, separated from eye by one row of scales. Inferior labials nine to 11, first pair in contact on median line. Scales in 21 or 23 rows, keeled except in parts of the first and second rows. Gastroteges varying from 151 to 162. Anal entire. Urosteges 19 to 27, the

to three rows of scales wide. They are separated from the other blotches on the same side of the back by about one and one-half scales, and from those of the opposite side by the width of one scale. There are two or three rows of smaller alternating brown spots on the sides. The gastroteges, except anteriorly, are dark slate. The edges of the gastroteges and of the scales of the first row are whitish. The tip of the tail is bright salmon or flesh-color.

Length to anus....	309	319	395	406	445	460	480
Length of tail to							
base of rattle....	32	29	38	41	30	40	43

"Distribution.—This beautiful little rattlesnake is known only from southeastern Arizona. It has been taken in the Huachuca Mountains, in Cochise County,

and at an altitude of 7,500 feet, on a ridge near Old Baldy, Madera Canyon, Santa Rita Mountains, Santa Cruz County. Another was taken near the summit of Old Baldy. It is said that this species occurs also in the Catalina Mountains. In the Chiricahua Mountains it has been collected on Onion Creek near Paradise, Cochise County. The National Museum has it from the Apache Forest, and from 6,100 feet altitude on Ash Creek, Mount Graham."

In the spring of 1926 I had the opportunity of examining both of Van Denburgh's description and figures of *C. pricei* comparatively with *C. triseriatus* as defined by Boulenger and represented by various herpetologists previously to 1896, as well as with several specimens supposedly of the latter form contained in the Museum of Comparative Zoölogy and received from different localities in Mexico. Throughout my study I became so impressed with the resemblance of these two forms that during the visit I paid to the California Academy of Sciences, in July, 1926, I requested of Dr. B. W. Evermann permission to examine Van Denburgh's material in order to form a personal opinion on the validity or on the range of various western species of snakes. Naturally, the status of *Crotalus pricei* was one of the most important questions I was trying to settle. Having had access to the collection, through Dr. Evermann's kindness, I wrote some notes on Van Denburgh's material as completely as I could, under the circumstances, and, having returned to the East, I decided to borrow more material from both the Museum of Comparative Zoölogy and the United States National Museum in order to bring my study to a conclusion.

MATERIAL EXAMINED

The material examined consisted of the collection organized by Van Denburgh in the Museum of the California Academy of Sciences and two large series of specimens existing, one in the Museum of Comparative Zoölogy, and the other in the United States National Museum. In regard to the former material, which consists of 7 specimens, I refer the reader to Van Denburgh's description as quoted above and to his plate of *pricei*, now reproduced with permission of the California Academy of Sciences. The latter material may be briefly arranged by localities as follows:

M. C. Z. Nos. 14815 and 14816, from Huachuca Mountains, Cochise County, Arizona, U. S.

M. C. Z. No. 6875, from San Blas Mountains, Chihuahua, Mexico.

M. C. Z. No. 15860, from Pacheco, Chihuahua, Mexico.

M. C. Z. Nos. 6783, 7092, 19050 to 19059 (10) and 22916 to 22922 (7), from Colonia Garcia (Sierra Madre) Chihuahua, Mexico (2100 ms. altitude).

M. C. Z. Nos. 22923 to 22930 (8), from Alvarez, S. Luis Potosi, Mexico.

M. C. Z. No. 11425, from San Miguel, Hidalgo, Mexico.

U. S. N. M. No. 36471, from Chiricahua Mountains, Cochise Co., Arizona, U. S.

U. S. N. M. No. 56178, from Cochise Co., Arizona, U. S.

U. S. N. M. Nos. 51427, 51428, from Ash Creek, Mount Graham, Arizona.

U. S. N. M. No. 55858, from Chihuahua, Mexico.

U. S. N. M. No. 26594, from Rio Pedras Verdes, Chihuahua, Mexico (1900 ms. alt.).

U. S. N. M. No. 40062, from Distrito de Guerrero, Chihuahua, Mexico.

U. S. N. M. Nos. 42494, 42495, from Distrito de Guerrero, Chihuahua, Mexico (2130 m. alt.).

U. S. N. M. No. 42498, from Distrito de Guerrero, Chihuahua, Mexico (2250 m. alt.).

U. S. N. M. Nos. 46327-46329 (3), from Colonia Garcia, Chihuahua, Mexico.

U. S. N. M. No. 46350, from Guadalupe y Calvo (Sierra Madre), Chihuahua, Mexico.

U. S. N. M. No. 42865 (+ 7 yg. unborn), from near Chuichupa, Distrito de Galeana, Mexico (2418 m. alt.).

U. S. N. M. No. 46402, from Miquihuana, Tamaulipas, Mexico.

U. S. N. M. No. 46465, from Ameca, Jalisco, Mexico.

U. S. N. M. No. 46343, from Omilteme, Guerrero, Mexico.

Total: 6 specimens from the United States and 44 (+ 7 yg. unborn) from Mexico.

In regard to the colouration of the dorsum, all stages are represented in this series. There are specimens of the spotless phase, almost unicolor, like *pallidus*, others with very small dorsal spots, and still others with rather large and numerous dorsal markings. Specimens Nos. 11425 (M. C. Z., from Hidalgo, Mexico), 19058 (M. C. Z., from Chihuahua, Mexico) and 46465 (U. S. N. M., from Jalisco, Mexico), for instance, show no spots along the back; Nos. 19053, 22917 and 22921 (M. C. Z., from Chihuahua, Mexico) are more or less profusely speckled with dark; Nos. 14816 (M. C. Z., from Arizona, U. S.), 19050 (M. C. Z., from Chihuahua, Mexico), 36471 and 51428 (U. S. N. M., from Arizona, U. S.) hardly show 2 para-vertebral series of dark spots; Nos. 22929 (M. C. Z., from San Luis Potosi, Mexico) and 42494 (U. S. N. M., from Chihuahua, Mexico) bear confluent transverse spots like narrow cross-bands along the back; a few of the remaining specimens from both the United

States and Mexico have 2 para-vertebral series of rather small dark markings, rounded or elongated, and one to three series of minute spots irregularly arranged on each side, whilst Nos. 19051, 19056, 19057, 19059, 22916, 22918, 22919, 22920 and 22922 (M. C. Z., from Chihuahua, Mexico), 22923, 22924, 22925, 22927 (M. C. Z., from San Luis Potosi, Mexico) and 51427 (U. S. N. M., from Arizona, U. S.) have 2 series of small irregular spots on each side, besides one vertebral series of large markings, elongated longitudinally, a few of which clearly show that they result from the tranverse or even longitudinal coalescence of 2 or 4 adjacent small markings; No. 19052 (M. C. Z., from Chihuahua, Mexico), is intermediate to the two preceding groups in that it has one lateral series of small spots besides the vertebral markings which are arranged in two series anteriorly and in one posteriorly; Nos. 19055 (M. C. Z. from Chihuahua, Mexico), 22926, 22928 and 22930 (M. C. Z., from San Luis Potosi, Mexico) have one series of large irregular vertebral markings and one lateral series of small spots; finally, No. 19054 (M. C. Z., from Chihuahua, Mexico) has 2 para-vertebral streaks along the neck and the anterior part of the body, one series of elongated markings in the middle of the body gradually turning into cross-bars towards and on the tail.

Now, if, on the one hand, we examine Van Denburgh's photograph of a typical *C. pricei* from Arizona as herewith reproduced in Fig. 11, comparatively with Fig. 10, which represents the specimen M. C. Z. No. 22928, from San Luis Potosi, we shall see that the shape of their head, body and rattle, their physiognomy and type of pattern are very much the same. On the other hand, if we study critically the figures on the pholidosis of all specimens, no matter from where they have come, we shall realize that the differences found are in no way so clear cut as to permit of keeping the American specimens separate from the Mexican ones.

Therefore, this comparative study seems to warrant the conclusion that the distinction between *C. pricei* and *C. triscriatus* is merely a geographical one and thus the name *C. pricei*, being posterior, must fall into the synonymy of *C. triscriatus*.

Now, I must take this opportunity to redescribe the species *triscriatus* in the light of the new facts brought out by the present revision as follows:

Crotalus triscriatus (Wagler, 1830)

Size rather small. Head subtriangular, with flattened top and rounded canthus rostralis. Rostral about as broad as high in contact with anterior nasal and internasals; two nasals; two internasals, rather large, triangular, touching each other; two canthals (between supraoculars and internasals); separated from each other by 0-6 intercanthals, small, scale-like; supraocular large, rather flat, separated from its fellow by from 1 to 5 or even 6 scales; 1 or 2 loreals; 2 preoculars; 9-14 upper labials, separated from eye by 1-2 scale rows. Dorsal scales in 21, 22, 23 or 25 rows, keeled except some of the 1st and 2nd paraventral rows; scale keel long and low. Ventrals 137-184 (♂♂ 137-162, ♀♀ 150-184). Anal entire. Subcaudals 18-30 (♂♂ 22-30, ♀♀ 18-25), a few divided. Rattle slender, nearly even, delicate.

Colouration—greyish olive above speckled with brown or thickly covered with minute brown dots, with or without one or two vertebral series of small to large blackish light-edged spots or blotches, exceptionally forming longitudinal streaks on neck, and with or without one, two or even three series of small dark spots irregularly arranged along each side, the vertebral and the lateral markings becoming elongated transversely and coalescing posteriorly towards the posterior part of the body so as to form cross-bands on the tail; head greyish or brownish above usually with 3 cross-markings, the first on canthals, the second on supraoculars and the third on parietal region, with 2 elongated dark markings on occiput and with one blackish brown light-bordered band extending from behind and below the eye to a little beyond the corner of the mouth; upper lip cream coloured; under surface either greyish brown powdered or speckled with light or yellowish more or less profusely speckled, dotted or spotted with dark slate, the edges of the ventrals, subcaudals and paraventral row of dorsal scales being light.

Hemipenis—elongated, bifurcated, non-capitate; sulcus forked; base smooth inferiorly, with 6-8 rows of small spines beginning just below the forking of the sulcus; distal and covered with 20-25 rows of small calyces with fringed borders.

Maximum size found—630 mm. (M. C. Z., No. 19050).

Living habits—This snake is found in moun-

TABLE I
COUNTS AND MEASUREMENTS

Coll. and No.	Sex	Labials	Inter-orbito-labial scales	Internasals	Canthals	Intercanthals	Sc.	V.	C.	Length in mm. (rattle excluded)	
										Total	Tail
M. C. Z. 14815	♀	10/9	1-2 rows	2	2	2 smaller	21	158	20	440	32
14816	♀	10/9	1-2 rows	2	2	2 smaller	21	165	23	435	31
6875	♂	9/9	1-2 rows	2	2	4 small	21	161	23	474	40
15860	♀	9/9	1 row	2	2	4 small	22	160	16 + 4 p.	402	28
6783	♂	9/9	1-2 rows	2	2	3 small	21	156	24	530	45
7092	♀	9/9	1-2 rows	2	2	4 small	23	167	23	432	29
19050	♂	10/10	1-2 rows	2	2	4 small	21	161	25	630	45
19051	♂	9/10	1-2 rows	2	2	3 small	23	152	26	562	52
19052	♀	12/12	1-2 rows	2	2	4 small	23	158	25	384	26
19053	♀	12/12	1-2 rows	2	2	4 small	21	153	24	448	32
19054	♀	12/12	2 rows	2	2	4 small	23	158	21	439	31
19055	♀	12/12	2 rows	2	2	4 small	23	155	25	472	34
19056	♂	12/12	1-2 rows	2	2	3 small	21	160	27	465	39
19057	♂	12/11	2 rows	2	2	4 small	23	162	28	395	35
19058	♂	13/12	2 rows	2	2	3 small	21	161	30	586	53
19059	♀	11/10	1-2 rows	2	2	2 smaller	21	155	14 + 5 p.	201	13
22916	♀	12/11	2 rows	2	2	4 small	23	153	20	284	22
22917	♀	12/12	2 rows	2	2	4 small	22	153	15 + 4 p.	252	18
22918	♂	11/12	1-2 rows	2	2	2 smaller	23	149	26	260	21
22919	♀	11/11	2 rows	2	2	3 smaller	23	153	13 + 5 p.	256	17
22920	♂	13/12	1-2 rows	2	2	4 small	23	153	21 + 8 p.	223	20
22921	♀	14/13	1-2 rows	2	2	4 small	23	156	19	232	16
22922	♀	11/11	1-2 rows	2	2	2 + 2 small	21	155	19	248	17
22923	♀	11/11	1-2 rows	2	2	2 + 1 small	23	156	20 + 2 p.	528	35
22924	♂	12/13	1-2 rows	2	2	6 small	23	154	22 + 5 p.	500	44
22925	♂	12/12	1-2 rows	2	2	5 small	23	159	24 + 2 p.	577	50
22926	♂	11/11	1-2 rows	2	2	3 small	23	155	23 + 2 p.	553	46
22927	♂	10/11	1-2 rows	2	2	1 + 2 small	25	154	25	572	52
22928	♂	13/12	1-2 rows	2	2	5 small	23	156	21 + 5 p.	419	34
22929	♀	12/12	2 rows	2	2	5 small	23	159	20 + 1 p.	378	26
22930	♀	12/12	1-2 rows	2	2	2 smaller	23	156	16 + 3 p.	422	29
11425	♀	11/11	1-2 rows	2	2	0	21	150	20	460	34
U. S. N. M. 36471	♀	9/9	1-2 rows	2	2	4 small	23	168	21	223	15
56178	♂	9/9	1-2 rows	2	2	2 smaller	21	155	25	207	18
51427	♀	9/8	1-2 rows	2	2	2	21	166	22	522	35
51428	♂	9/9	1-2 rows	2	2	1 + 2 smaller	21	156	23	208	18
55858	♀	9/9	1-2 rows	2	2	4 small	21	162	21	365	24
26594	♀	9/9	1-2 rows	2	2	2 smaller	21	167	21	386	26
40062	Skin						21				
42494	Skin						21				
42495	Skin						21				
42498	Skin						21				
46327	♂	9/9	1-2 rows	2	2	2 smaller	21	157	28	407	35
46328	♀	9/9	1-2 rows	2	2	3 smaller	21	164	23	315	22
46329	♂	9/9	1-2 rows	2	2	2 smaller	21	153	25	254	21
46350	♀	9/9	1-2 rows	2	2	2 smaller	21	156	23	406	31
42865	♀	9/9	1-2 rows	2	2	4 small	21	164 + n	22	406	31
46402	♂	9/9	1-2 rows	2	2	2 smaller	21	137	27	346	35
46465	♂	12/12	2 rows	2	2	2 smaller	23	147	22	410	34
46343	♂	9/9	1-2 rows	2	2	2 + 2 small	21	168	17 + 12 p.	222	18

tainous, high, dry and rocky places and feeds on lizards, particularly *Scelopori*.

Note—*C. triseriatus* appears to be, in the entire genus *Crotalus*, the closest form to the genus *Sistrurus*. I also believe it is perhaps the most primitive representative of its own genus. Indeed, as far as I can judge, the head shields, canthus rostralis, rattle, hemipenis and colouration of *triseriatus* are all of the primitive type.

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16. ON THE SEASONAL INCIDENCE OF THREE COMMON SPECIES OF MASSACHUSETTS SNAKES,

THAMNOPHIS SIRTALIS SIRTALIS (LINNÉ); *STORERIA DEKAYI DEKAYI* (STORER); AND *LIOPELTIS VERNALIS* (HARLAN)

By ARTHUR LOVERIDGE

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Though the following observations may be of little interest at the moment, it occurred to me that they may become interesting in the future because relating to a district which is being very rapidly built over.

The period covered is from April 18th, 1925, to March 5th, 1926.

During this period I occupied a house a hundred yards from the Quincy Shore Reservation at Norfolk Downs, Mass. All the 287 snakes referred to were taken in a patch of swampy waste ground lying a hundred and fifty yards from my house. This area was of irregular outline but approximately 300 x 200 yards at its greatest length and breadth. At the end nearest my house was fifty yards of pleasant, grass-grown bank facing west. Upon it were a few scattered stones as well as fragments of asbestos-linoleum

discarded by builders who employ it in place of roofing tiles. To the left was a dump of several tons of granite boulders and chips, also discarded by builders. The observations show that in this location snakes may be caught during at least ten months of the year; quite possibly eleven, as packing-up and departure prevented any search being made in March, 1926.

It was observed that while the bank was the favourite haunt of young individuals of all three species to which I am about to refer, as well as adult Dekay's Snakes, the stone pile, together with four boards lying near it, were the headquarters of all the larger Garter and Green Snakes. At the far end to the right was a rubbish dump abutting on some flag-grown swampy ground that was under water in April but which dried-up shortly afterwards. Scattered tins,

saucepans, boxes, cartons and linoleum in the proximity of this dump were at first very productive of Dekay's Snakes. Some bushes halfway between the dump and the bank were possibly the best place for Green Snakes which might be found beneath the few tins that lay among the bushes.

It may be contended that I furthered the work of extermination by catching so many snakes at one spot. On the other hand it is obvious that the place is doomed as a reservation for it was surveyed for building purposes in May. Even during the time that we were there a causeway consisting of hundreds of tons of sand was made across one corner completely burying the stone pile together with its occupants. No fewer than ten houses were erected in the short road from the shore to this area in as many months. The place was bounded by roads on every side so that it was no infrequent occurrence to find the crushed or battered remains of venturesome snakes that had essayed to cross the road. As if these dangers were insufficient small boys of the neighborhood were seen hunting them on several occasions.

The majority of these snakes were sent to the Zoölogical Societies of London and San Diego as gifts or in exchange for deceased material for use in the Museum of Comparative Zoölogy. A dozen Green Snakes were turned loose in a better location and two batches of the same were sent to Senckenburg Museum. No inconsiderable number were used to feed some Milk Snakes, *Lampropeltis triangulum triangulum* (Linné) and Holbrook's King Snakes, *Lampropeltis getulus holbrooki* (Stejneger) which were kept at the museum. In passing I might mention that one of the latter ate four Green and seventeen Dekay's Snakes during the period October 19th to November 20th. This Holbrook's Snake showed a decided preference for Dekay's Snakes as opposed to Garter Snakes of the same size which were more numerous in the vivarium.

Negative hunts are reported just the same as productive ones but, as a general rule, search was not made on obviously unfavorable days and observations were principally confined to Saturday afternoons and public holidays, though I am indebted to my wife and Miss H. Sloan for some collecting done when I was in town.

Less than five per cent of the reptiles were taken basking or moving above ground, the remainder were enjoying the warmth to be ob-

tained beneath tins, linoleum, etc. The biggest catches were fifty taken in one afternoon, thirty in two hours and thirty-three in three hours. It is interesting to note that the Garter Snakes occur in almost the same proportion as Dekay's Snakes, 103 to 110, but while fully fifty per cent, possibly more, of the latter were full grown, certainly not more than twenty per cent of the Garter Snakes were of mature size. I suggest this discrepancy is due to the more active and less secretive habits of the larger reptiles bringing them under human observation and resulting in their death. As no frogs were to be found and only a single toad, it may be that the lack of these is an incentive to wandering if the Garter Snakes become discontented with a diet of worms on reaching maturity.

A Dekay's Snake taken on 2.v.25, depressed its body to a surprising extent in an effort to appear dangerous. It also exuded a smell like rotten eggs. The dorsal line varied in specimens taken the same day from blue-grey to greyish-olive. Iris orange, pupil black, tongue black, mouth flesh-red. The smallest Dekay's Snake (taken 10.v.25) measured 184 (102 + 82) mm. One of the finest Dekay's Snakes seen during the time I was in the States was a female caught at Newton Centre, Mass. on 5. viii.24 by Dr. Friedmann who presented it to the Museum of Comparative Zoölogy (M. C. Z. No. 18976). On being chloroformed it was found to contain twenty embryos. It measured 361 (290 + 71) mm. A curious location for one of these snakes was beneath the cloth of an ironing board. It was discovered by a member of Dr. Friedmann's household when endeavoring to smooth out a lump in the cloth!

Ten fresh Green Snake eggs were found beneath a box on 28.vii.25. These varied slightly in size from 20 x 11 mm. to 21 x 10 mm. They were kept in damp sphagnum moss in a warm, dark, cupboard. The moss on becoming dry was watered every third day. The eggs appearing rather collapsed, I opened one on 19.viii.25 and was surprised to find it held a living snake 115 (85 + 30) mm. long = $4\frac{1}{2}$ inches. On looking at the eggs at 9.30 a.m. the following day (20. viii. 25), I found the head of a young snake just protruding from a shell; at 10 a.m. it was in the same position but by 11 a.m. it had emerged. On hatching, the colour appears almost black but is in reality dark greyish-olive. On the 21st another snake emerged. I did not look at the

TABLE II

Date	<i>Thamnophis sirtalis sirtalis</i>	<i>Storeria dekayi dekayi</i>	<i>Lio-peltis vernalis</i>	Total catch	Remarks
1925					
April 25	1	0	0	1	Garter muddy and lethargic, a second seen killed on path. Took a toad.
26	4	4	1	9	Really hot midsummer day. Garters young. All snakes beneath stones or drums.
27	2	0	1	3	Morning sunny, southwesterly wind, day more or less cold. One Garter, half-grown, in tin, a smaller beneath stone.
May 2	0	2	0	2	Sunny at time but very cold wind blowing from south-west. Both Dekay's taken beneath asbestos linoleum.
3	0	0	1	1	Green snake half-grown beneath asbestos linoleum almost buried in grass.
9	0	1	3	4	
10	9	12	9	30	Three Garters were together in fold of tarpaulin, no two Dekay's were taken together but with Garter or Green several times. One Dekayi freshly dead was very small.
12	0	0	1	1	One Dekayi very small. On way home from station turned over a sack of linoleum at 6 p.m. and took the fifth large Green from this spot in three days.
17	11	7	15	33	Five Garters were together, saw two others basking on tussocks of grass, but they escaped. The majority of the Green were more than three-quarters grown, one was in a bush, the rest beneath linoleum, etc.
24	0	0	1	1	Very cold day with east wind, temperature about 48°. Green snake with amputated tail under sacking.
26	3	0	3	6	Rather sunless day yet took these snakes at 6 p.m. One Garter and three Dekay's beneath a board, another Garter under stone, another under linoleum. Three very young Green, all beneath board.
31	16	22	12	50	Also saw 3 freshly-killed Green.
June 3	4	0	1	5	All Garters beneath linoleum. A half-grown Green at 7 p.m. beneath a tin.
7	4	3	1	8	The last four days and today until noon have been very hot.
14	? 4	? 5	0	9	Temperature not below 76° whole time, day or night and during the day from 80-96°. I considered it too hot for snakes as I went out from 7-8 a.m. this morning, blazing sun in blue sky and only found 1 Garter about to slough beneath a big drum. At 12.30 p.m. a sudden strong east wind arose and caused a drop, and by 2.30 the sky was clouded over. Visited all sites again and found 1 Green under felt. At 4 p.m., 2 young Garters under newspaper, 1 under saucepan in mud. Five Dekay's in all were seen under newspapers and a board, all non-heat-conducting situations. Though cold beneath tins, stones, etc., the ground itself still remained warm, even hot in some places.
17	2	3	2	7	
18	7	2	0	9	Taken between 5.30-6.30 p.m., bright sunshine. Saw two other Garters, one of which was above ground. One Dekay's under paper, the other under stone.
21	5	2	0	7	Ideal day. Took no Garters at 9-10 a.m., but five between 2-4 p.m. These were under boards and linoleum, stones being too hot. The reverse with Dekay's, both being taken on stone heap 9-10 a.m.
July 5	0	1	0	1	Taken crossing path to station at 5 p.m.; nothing under stones.
12	5	0	0	5	Five Garters taken under boards by stone heap, a sixth escaped. Also failed to catch the disappearing tail of a fat female Green.
16	3	0	0	3	Could find nothing at 8 a.m. The three Garters were taken by stone heap at 6 p.m.
17	1	0	0	1	Garter, from stone heap, large like all those taken recently, captured at 5 p.m.
18	1	2	0	3	Weather sunny but not unpleasantly hot as there was a cool breeze, a very thorough search of whole area at noon.

TABLE II—Continued

Date	<i>Thamnophis sirtalis</i>	<i>Storeria dekayi</i>	<i>Lio-peltis vernalis</i>	Total catch	Remarks
1925					
July 19	2	0	0	2	Nothing under boards at 11 a.m.; two half-grown taken at 5 p.m., one under board, the other beneath a stone.
24	0	1	0	1	
26	1	0	0	1	At 6 p.m. saw two young snakes beneath board but only captured one.
28	0	1	0	1	At 5.15 p.m. weather dull with storm threatening; a large Dekay's crossed my path as I returned from station.
29	1	0	0	1	
30	2	1	0	3	At 6 p.m. took two young Garters and one large Dekay's, under boards near stone pile.
31	2	1	0	3	At 5.15 p.m., under boards. All young.
August 1	4	0	3	7	An incomplete survey. A very large Garter under oilcloth, another big one under a board, two young beneath a stone. Three half-grown Green beneath stones.
2	0	0	0	0	Weather cool, sunny; visited boards at 10 a.m., 12 noon and 5 p.m. without finding a reptile.
4	2	0	0	2	One of these was a female with eight young in oviducts, each measuring 100 mm.
9	0	1	0	1	I visited the boards several times during the past few days without result, with the exception of an adult Dekay's today. Later as a control I spent 20 minutes in a quarry a mile distant and took 8 Garters, all ages, beneath slate, boards and metal. The day was dull but very close.
September 5	0	1	0	1	A half-grown very coppery coloured specimen beneath a board.
6	0	0	1	1	A recently hatched Green, about to slough, beneath linoleum.
7	0	0	0	0	The Dekay's taken on 5th was swallowed by a 300 mm. Milk snake but very little larger than the Dekay's.
12	0	0	0	0	At West Quincy an almost full-grown Garter taken as it lay extended across the path about 5 p.m.
17	1	0	0	1	The young Garter taken was one of three snakes seen.
19	0	1	1	2	An exhaustive search 2-4 p.m. on a sunny cool afternoon resulted in a Garter beneath cardboard, Green beneath board.
October 10	2	0	0	2	Snowed from dawn till noon and spasmodically in afternoon. Adult basking on bank, yearling beneath linoleum.
11	0	0	4	4	At 12.30 p.m. bright sunshine, though very cold wind. Snow still lying in patches in shady spots. All four snakes were quite young and taken on bank.
16	0	0	1	1	As I hurried to train at 8.30 a.m. I passed a youngster carrying a stick and chanting "I've killed a Rattlesnake." It was a Green snake presumably above ground at that early hour.
17	2	3	4	9	Sunny in short spells, one Dekay's and one ten-inch Green were basking, the others were very young, a fifth was seen.
18	1	9	5	15	Young Garter under linoleum in company with a baby Dekay's and a baby Green at noon. Of the rest four Dekay's were taken at 4.10 p.m. though the sun was low, and weak all afternoon.
19	0	2	0	2	Taken at 4 p.m. by my wife who found three under a piece of linoleum on a bank.
24	0	15	4	19	Morning sunny. Returning home at 1 p.m. I saw two small boys who gave me the nineteen snakes (ten of which were adult) and which they had taken on bank.
31	0	2	0	2	Returning home at 1 p.m. I turned over favourite linoleum and saw two adult Dekay's beneath. It was sunny at time, but the wind was cold.
November 15	0	3	0	3	Returning home at 1 p.m. I turned over favourite linoleum and saw three adult Dekay's beneath, which I left. It was sunny and fairly warm.

TABLE II—*Concluded*

Date	<i>Thamnophis sirtalis sirtalis</i>	<i>Storeria dekayi dekayi</i>	<i>Liopeclis vernalis</i>	Total catch	Remarks
1925					
November 21	1	1	0	2	Though cold, it was a sunny morning. I took a large Garter basking on bank.
22	0	3	0	3	Removed two from favourite linoleum, the third elsewhere after a fairly good search.
26	0	0	0	0	Sunny but cold wind, ice on all water, no snakes on bank or under favourite linoleum.
December 6	0	4	0	4	After three mild days of almost continuous rain, the sun came out. At 11.30 a.m., I turned over four stones on bank and took four adult Dekay's beneath the second.
1926					
January 30	0	1	0	1	Thaw after two days bitter weather 4° above zero. At 3.45 p.m. I took an adult under stone on bank with drifts of slushy snow all around. Cold sunshine.
Total.....	103	110	74	287	

eggs on the 22nd, but found that two more had hatched by the 23rd. On the 24th another came out so they apparently hatched at the rate of one per day. On 4. IX. 25, as no more had emerged, the remaining four eggs were examined and found to contain dead embryos. Three of these young were given away, the remaining two were eaten by a baby Milk Snake 300 mm. in length—which had been placed in their vivarium half an hour before. The inside of the mouth of young Green Snakes is blue, a striking contrast to the red of Dekay's and Garter Snakes. A rather peculiar

thing in relation to the incidence of occurrence of Green Snakes at Norfolk Downs was their absence above ground from the middle of June till the end of July.

Several of the snakes, more particularly young Green Snakes, taken in the spring were found to have numerous pimples beneath the skin. No parasites could be detected in these but they multiplied and caused trouble in sloughing and doubtless would have resulted in death had not the infected individuals been removed from the vivarium and chloroformed.

ON *TARBOPHIS FALLAX CYPRIANUS*

T. Barbour and A. do Amaral described this new form for Cyprus, in Bulletin of the Antivenin Institute of America, I. 1:27, 1927. They, however, omitted in their description the number of the type, which is No. 22375 in the collection of the Museum of Comparative Zoölogy.

A. DO AMARAL.

ON *PSEUDECHIS AUSTRALIS* (GRAY)

In a small collection of reptiles from Merauke, South-west New Guinea, collected by Mr. P. T.

L. Putnam who has presented them to the Museum of Comparative Zoölogy, is an example of this rare elapine snake which is unique in having all, instead of part, of its subcaudals single. This snake (M. C. Z. No. 22811) is slightly larger than any known specimen but agrees in all other respects with the characteristics of the species. Further particulars of it are: Length of head and body 937 mm., Length of tail 158 mm., Mid-body scale rows 17. Ventrals 191. Anal divided. Subcaudals 53.

ARTHUR LOVERIDGE.

M. C. Z., Cambridge, Mass.

17. AUTO-HEMORRHAGE IN TROPIDOPHIS SEMICINCTUS

By P. J. DARLINGTON, JR.

From the Biological Laboratory in Cuba (Atkins Foundation) of the Harvard Institute for Tropical Biology and Medicine

The writer spent the eight weeks from October 14 to December 9, 1926, at the Harvard Biological Laboratory, Soledad Central, near Cienfuegos, Cuba, engaged principally in collecting beetles. From time to time, however, with the Museum of Comparative Zoölogy in mind, reptiles were taken, and among them a series of thirteen specimens of the snake *Tropidophis semicinctus* (Gundlach and Peters). The aggregate of notes taken on this species seems sufficient to prove definitely that it is regularly capable of auto-hemorrhage. The evidence may be tabulated as follows:

1. The majority of specimens taken were observed to bleed from the mouth; no specimen examined for the phenomenon failed to bleed; in no other of the two dozen or so snakes of other species handled in Cuba during the same period was bleeding noted.

2. In two specimens which were handled gently no blood was produced at first, but bleeding from the mouth commenced as soon as the

posterior parts of the body were treated roughly.

3. Under one stone two *T. semicinctus* were found coiled with a large *Arrhyton*, and were probably exposed to the same pressure when the stone was turned. Both *semicinctus* bled, the *Arrhyton* did not.

When taken, the snake coils into a ball with its head in the middle and offers no physical resistance. A very offensive anal secretion is produced, however, and immediately thereafter auto-hemorrhage begins. The blood is allowed to flow slowly from the mouth with no sign of being ejected under pressure, and is usually sufficient to form about four large drops. During the bleeding the eyes turn from a dark, inconspicuous shade to a color most aptly described as "ruby-red." The blood itself is very nearly odorless, certainly far less offensive to human nostrils than the anal secretion. Unfortunately it did not occur to the writer to taste it for possible defensive flavors.



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Bulletin of the Antivenin Institute of America

VOL. I

OCTOBER, 1927

No. 3

Edited by

AFRANIO DO AMARAL and R. H. HUTCHISON

WITH THE COLLABORATION OF OTHER MEMBERS OF THE STAFF OF THE INSTITUTE

The BULLETIN contains scientific contributions to, and current information on, the relation of snakes and other poisonous animals to man, with special reference to the highly venomous species of North and Central America, the West Indies, and northern South America. The subject matter covers taxonomy, biology and geographical distribution of species; the economic and public health aspects of the snake-bite problem; the collection of venoms, their composition, properties, and physiological effects; the production of antivenins; and related serological and immunological problems.

Address all communications to the BULLETIN OF THE ANTIVENIN INSTITUTE OF AMERICA, Box 1404, Philadelphia, Pa.



18. NOTES ON NEARCTIC POISONOUS SNAKES AND TREATMENT OF THEIR BITES

By AFRANIO DO AMARAL

In the announcement made in the first issue of this BULLETIN, it was stated that one aim of the editors was to include in each issue one or more articles which might interest not only the specialist, but the nature lover, camper, tourist, construction engineer or others whose work or play brings to them the desire for accurate information on the subject of snakes and other poisonous animals. With this in view, I am writing the present article which deals particularly with the main points of distinction of the poisonous snakes of the Nearctic region, that is of Central Mexico, United States and Canada; their distribution, living habits and behavior, and also with the means advised for the prevention of their bites and for the relief of the symptoms resulting therefrom.

DIFFERENTIATION OF POISONOUS SNAKES

From a purely scientific standpoint, most snakes must be considered venomous, as they possess on each side of the head, beyond the eye, a more or less well-developed gland (supralabial) that yields a viscous secretion, capable of exerting a toxic or destructive action whenever it comes in contact with the inner tissues of animals. From a practical standpoint, however, only those snakes are considered poisonous which, upon biting, are able to inject the secretion of their supralabial glands more or less deeply into the tissues of their prey or enemy. These snakes are included in two groups, which in Ophiology are called "proteroglypha" and "solenoglypha."

The proteroglyph ophidians possess one small

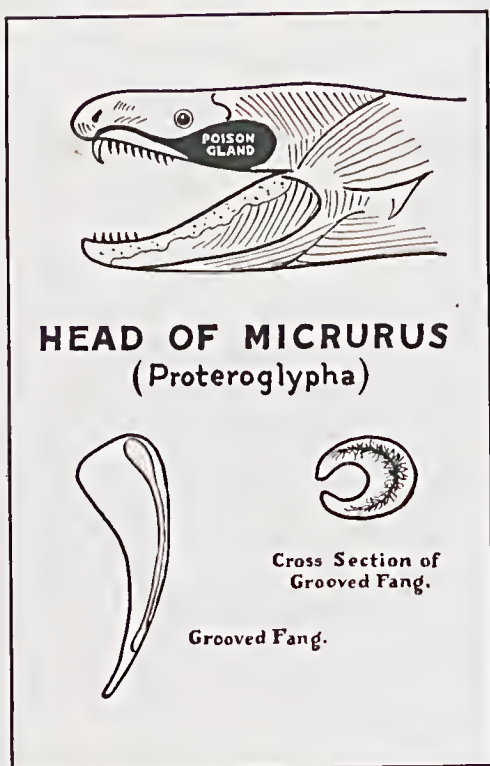


Fig. 1. Diagram of head and fang of a coral snake

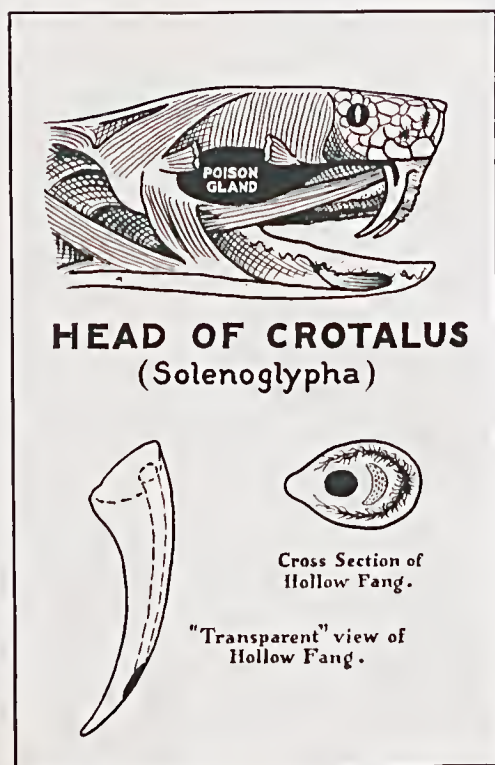


Fig. 2. Diagram of head and fang of a rattlesnake

fang longitudinally grooved and situated one on each side in the upper and front part of the mouth; each fang is implanted in the anterior portion of the maxilla and this is firmly attached to the other bones of the skull. The proteroglyph snake fangs are practically devoid of any motion



Fig. 3. Head of pit-viper. Note pit between nostril and eye

and this is one of the reasons why we know of so few bites inflicted by these snakes in this country. Another reason lies in the fact that the members of this group are rather tame or of gentle and amiable temperament and have a comparatively small mouth (Fig. 1). The "Coral Snakes" are the only representatives of this group in the Nearctic zone.

The solenoglyph snakes are provided with a very large fang, hollow like a hypodermic needle,

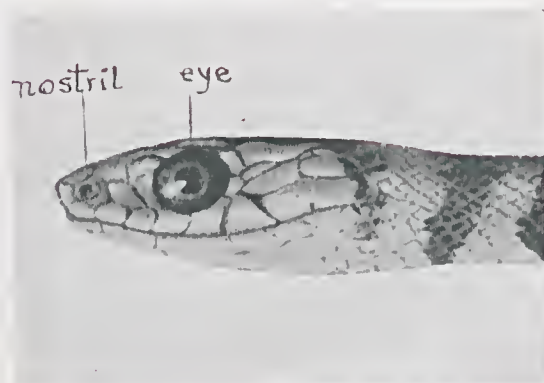


Fig. 4. Head of non-venomous snake. Note absence of pit between nostril and eye

and situated one on each side in the upper and front part of the mouth; but, contrary to what is found in the proteroglypha, these fangs are freely movable in many directions, as the maxillary bones in which they are implanted are very loosely attached to the skull, but very closely

connected with powerful muscles (Fig. 2). These snakes, which are responsible for almost all the accidents reported, are most commonly called "Pit-Vipers," because they bear on each side of the snout, between the eye and the nostril, a

supplemental pit or hole, which is never found in other snakes (Figs. 3 and 4).

The distinctive characters of the representatives of these two groups in the Nearctic zone may be summarized in the following key:

- | | | | | |
|------------------------------------|---|---|--|---|
| (a) Proteroglyph
"Coral snakes" | { Body slender and cylindrical, of red colour, with black rings edged with yellowish; head as wide as neck (genus <i>Micrurus</i>) | { Head black to about the eyes, then yellow; nape with a broad black ring followed by a yellow one— | } <i>M. fulvius</i> (Harlequin Snake). | |
| | | { Head all black; nape with a yellow ring followed by a black one— | | } <i>M. euryxanthus</i> (Sonoran Coral Snake) |
| (b) Solenoglyph
"Pit-vipers" | { Body voluminous and flat, of dull colours; head wider than neck | { Tail without rattle | { Head top covered with shields—genus <i>Agkistrodon</i> | |
| | | | { Head top covered with shields—genus <i>Sistrurus</i> | } <i>S. catenatus</i> (Massasauga)
<i>S. miliarius</i> (Pigmy Rattler) |
| | | { Tail with rattle | { Head top covered with scales—genus <i>Crotalus</i> | |

DISTRIBUTION AND HABITS OF POISONOUS SNAKES

Proteroglyphia

Micrurus fulvius, popularly known as the Harlequin Snake, is found all through the Southeastern States from North Carolina to Florida and westward through the Gulf States to Mexico. It abounds in humid places, and lives under the ground or in dead leaves and feeds on other snakes or on small subterranean lizards.

Micrurus euryxanthus, the Sonoran Coral Snake, is found more toward the Southwest, being apparently limited, in the United States, to the region between the Rocky Mountains and the Colorado River and thence south into North-



Fig. 5

Fig. 5. Body rings of false coral snake. Note yellow ring bordered by two black ones



Fig. 6

Fig. 6. Rings of true coral snake. Note black ring bordered by two yellow ones

western Mexico and also California. This snake, although accustomed to living in dryer places, is also found under the ground and feeds on other snakes or burrowing lizards.

The two species of *Micrurus* must not be mistaken for other red or bright-coloured ringed snakes also called "Coral-snakes," which, however, are not venomous. The false coral snakes can be told both from *Micrurus fulvius* and *M. euryxanthus* because in the former each yellowish ring is bordered by two black ones, just the reverse of the arrangement in *Micrurus*, in which the black ring is bordered by two yellowish ones (Figs. 5 and 6).

lives in the lowlands from Southeastern Virginia to Florida and the Keys and north through the Mississippi Valley to Southeastern Missouri and Southern Illinois and west through Texas to the Rio Grande. It is usually met with in swampy places or even in water and feeds on batrachians, fish and also rodents. The moccasin seems to be responsible for the majority of the bites observed in the Southeastern and the Gulf States, excepting Texas.

Sistrurus catenatus (Fig. 9), the Massasauga, is represented by two races, one living from Western New York through Southern Ontario (Canada) and the Southern Peninsula of Michi-



Fig. 7. A copperhead (*Agkistrodon mokasen*), which sometimes attains length of about 3 feet (90 cm.)

Solenoglyphia

Agkistrodon mokasen (Fig. 7), the Copperhead, also called Highland Moccasin, Chunkhead, Deaf Adder, Pilot Snake and Poplar Leaf, inhabits the Eastern States from Massachusetts and Southern New Hampshire to Northern Florida west to central Illinois, Kansas, Arkansas and Texas. It is found in hilly and in rocky places, sometimes near streams, and feeds on mice and also frogs and small birds. This species causes about two-thirds of the bites that are reported in the Eastern States, especially in Pennsylvania, Maryland, Virginia and West Virginia.

Agkistrodon piscivorus (Fig. 8), the Cotton Mouth Moccasin, also called the Water Moccasin,

gan to Kansas, and the other being found from Western Kansas through Oklahoma and Western Texas to Southeastern Arizona and Northeastern Mexico. This wide-spread species inhabits prairies and swamps and lives on small rodents and batrachians.

Sistrurus miliarius (Fig. 10), the Pigmy Rattler, also called Ground Rattler, has about the same range as the Cotton Mouth Moccasin, since it is found from Southeastern North Carolina to Florida, west through the Gulf States to Western Texas and Oklahoma and north through the Mississippi Basin to Arkansas and Southern Missouri. The Pigmy Rattler seems to prefer dry ground and is usually found among leaves or in grass, where it finds rodents upon which it feeds. In the lowlands of Eastern Mexico lives

a third species of this genus, to wit, *Sistrurus ravus*, which shows about the same habits as the North American Massasauga. Both the Massasauga and the Pigmy Rattler do not grow very large and usually secrete very little venom. Nevertheless, several cases are known of bites and even death (of young people) caused by them.

Crotalus horridus (Fig. 11), the Timber Rattler, in many places known as the Banded Rattler, Black Rattler or Canebraker, is well-distributed all over the Northeastern States to Georgia in the South and to the Great Plains in the West. It is usually found on ledges or in crevices of



Fig. 8. A cotton-mouth moccasin (*Agkistrodon piscivorus*), whose length sometimes exceeds 4 feet (1.20 m.).

rocks, in woody and hilly districts and feeds on all sorts of rodents and occasionally on birds. This species is not very irritable and causes comparatively few bites.

Crotalus adamanteus (Fig. 12), known as the Eastern Diamond-back Rattler, is the largest of all poisonous species of North America, where its range extends from Southern North Carolina to Florida and the Keys and west to Louisiana and the Mississippi River. It is found about swamps and feeds on rodents. The poisoning caused by this snake, is, as a rule, very severe, producing extensive mutilation, when it does not end fatally.

Crotalus confluentus (Fig. 13), the Prairie Rattler, is found in the region of the Great Plains from Oklahoma, Kansas, Nebraska, South and North Dakotas to the adjacent region of Canada and west to the Rocky Mountains or a little beyond. As its common name indicates,



Fig. 9. The Massasauga (*Sistrurus catenatus catenatus*). Maximum size about 3 feet (90 cm.). By permission of the New York Zoological Society

it is a typical snake of the prairies; it feeds on all sorts of small rodents.

Crotalus atrox (Fig. 23), the Western Diamond-back Rattler, is found more toward the South and West, its range extending from Texas to California, and south into Mexico and Lower



Fig. 10. The Pygmy rattler (*Sistrurus miliarius*). Maximum size about 2 feet (60 cm.). Photo by R. L. Ditmars

California. It appears to like dry and rocky places and also agricultural districts, where it secures the necessary supply of rodents on which it subsists. This species alone is responsible for about one-fourth or one-fifth of the cases of



Fig. 11. The Timber rattler (*Crotalus horridus*), which sometimes attains length of $4\frac{1}{2}$ feet or more (over 1.40 m.). By permission of the New York Zoological Society

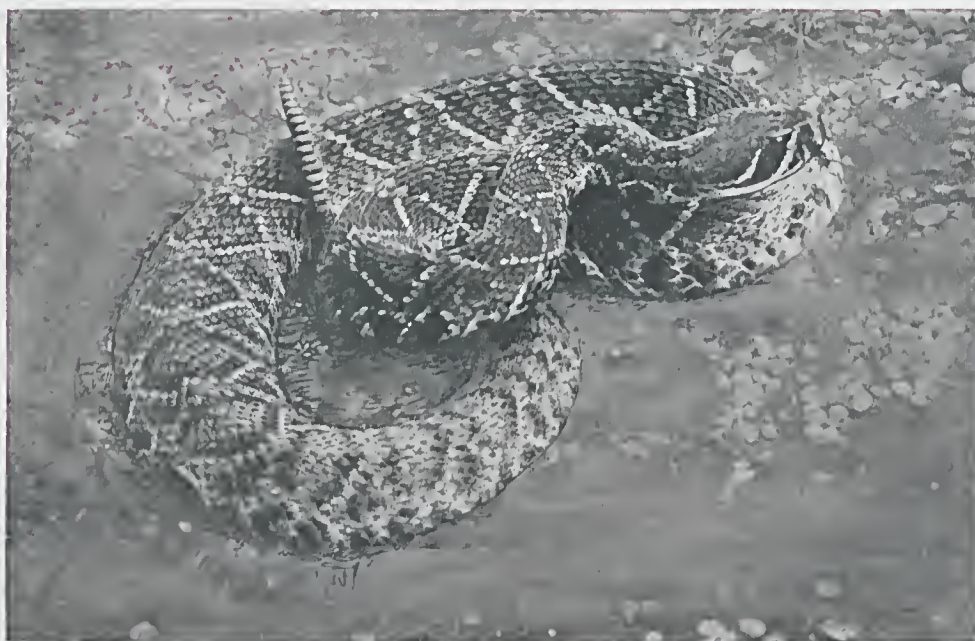


Fig. 12. The Eastern diamond-back rattler (*Crotalus adamanteus*), the largest of all rattlesnakes. Maximum size about 9 feet (2.70 m.)

poisonous snake bites reported in this country every year, with a death rate as high as 35 per cent.

Crotalus exsul (Fig. 14), the Red Rattler, from a morphological standpoint, is the nearest relative to the previous species. Its range extends from Southern California into Mexico, Lower Cali-

fornia and the Islands of the Gulf of California, therefore, overlapping to some extent the range of *Crotalus atrox*. It is found in rocky places, seldom away from cactus groves, and feeds on rodents.

Crotalus oreganus (Fig. 15), the Pacific Rattler, in some places known as the Black Rattler, is

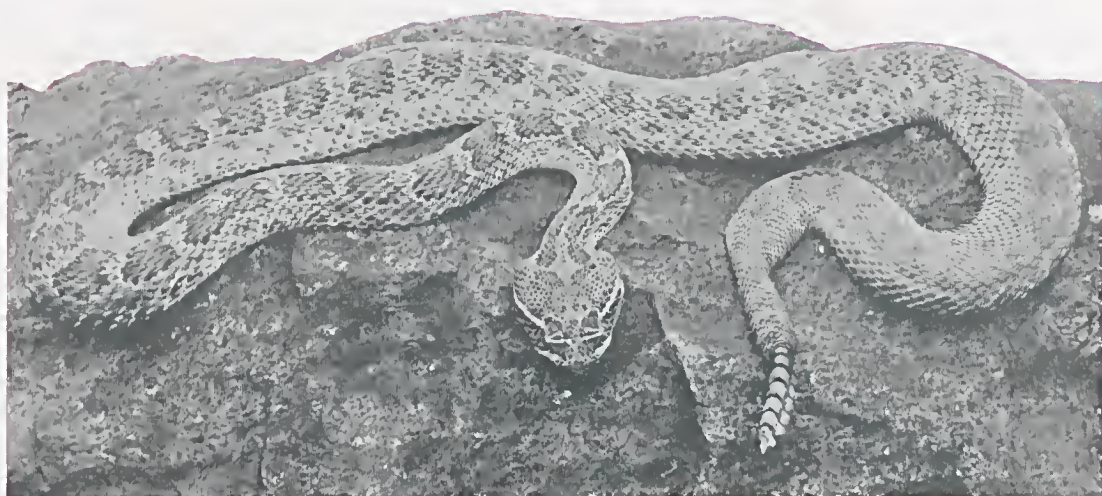


Fig. 13. The Prairie rattler (*Crotalus confluentus*). Maximum size 4 feet (1.30 m.). Photo by R. L. Ditmars

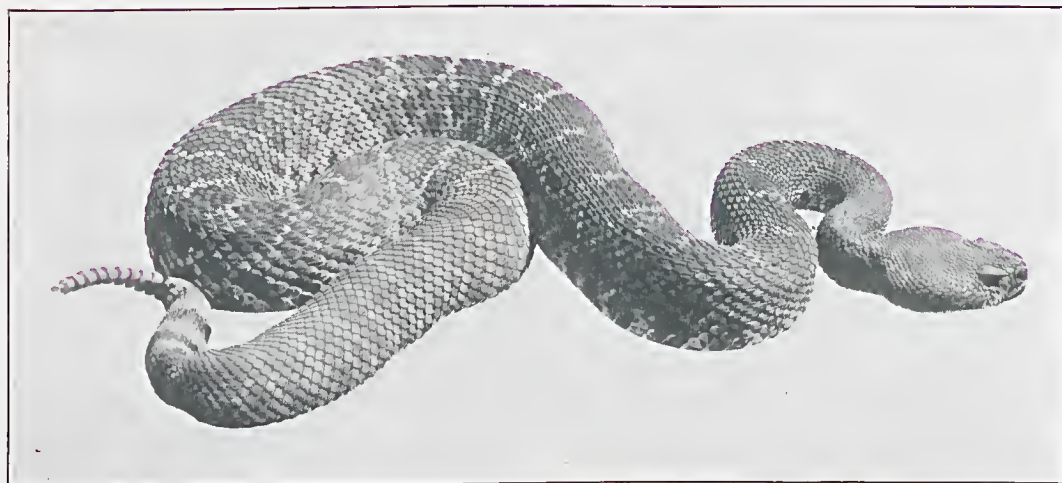


Fig. 14. The Red rattler (*Crotalus exsul*). Maximum size 6 feet (1.80 m.) Photo by Klauber



Fig. 15. The Pacific rattler (*Crotalus oreganus*). Maximum size 5 feet (1.50 m.) Photo by Klauber

found all over the West Coast, from British Columbia (Canada) to Southern California and east to Western Idaho, Nevada, and Arizona. It usually looks for shelter in mountainous and

from enemies during the day. As all the other rattlers, it comes out at night to seek food, which consists of rodents and lizards.

Crotalus molossus (Fig. 17), the Blacktail

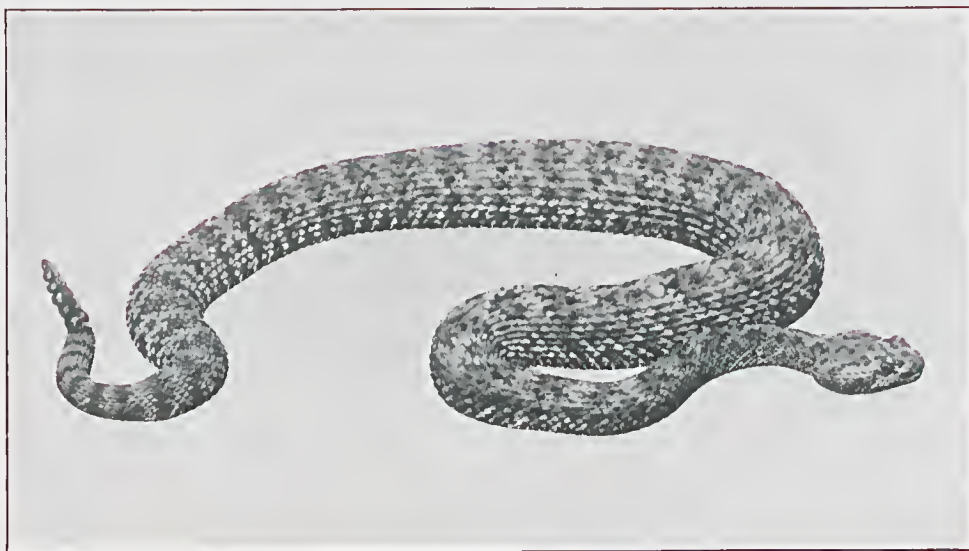


Fig. 16. The Bleached rattler (*Crotalus mitchellii*). Maximum size 4 feet (1.20 m.) Photo by Klauber

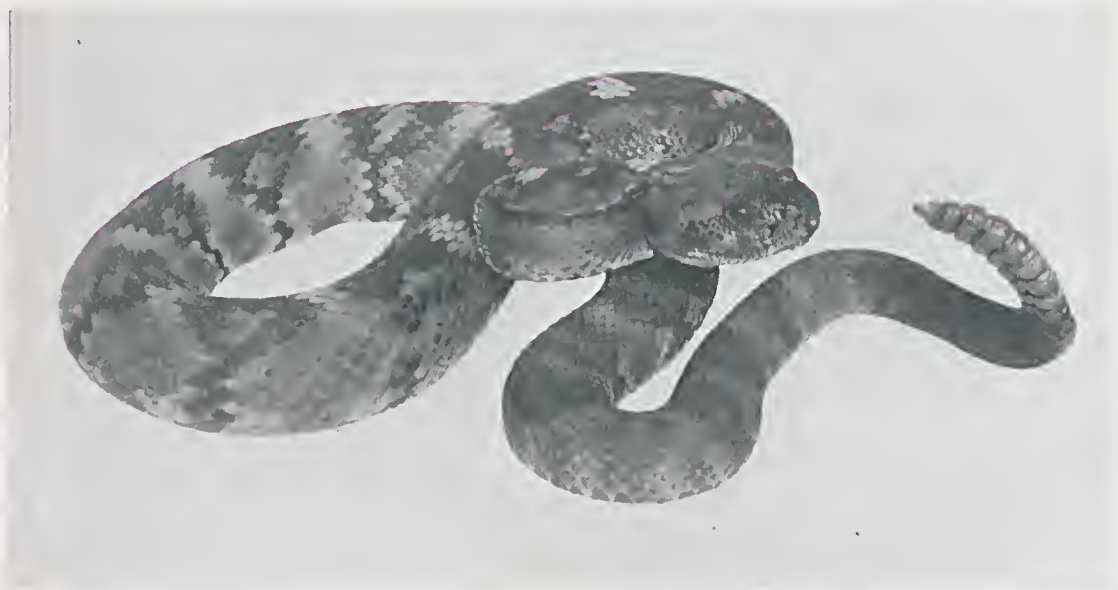


Fig. 17. The Black-tail rattler (*Crotalus molossus*), most handsomely colored rattler. Maximum size 4 feet (1.20 m.)

woody districts and feeds on rodents and occasionally on lizards.

Crotalus mitchellii (Fig. 16), the Bleached Rattler, inhabits the territory between Arizona, Southeastern California and Lower California, where it finds many rocky places, cactus groves and all kinds of thorny shrubs, where it hides

Rattler, inhabits the Southwest from Western Texas to Southern Arizona and the highlands of North Mexico, and is also said to be found on San Esteban Island in the Gulf of California.

Crotalus cerastes (Fig. 18), the Sidewinder or Horned Rattler, is found in the sand of the desert plains from Northeastern and Lower

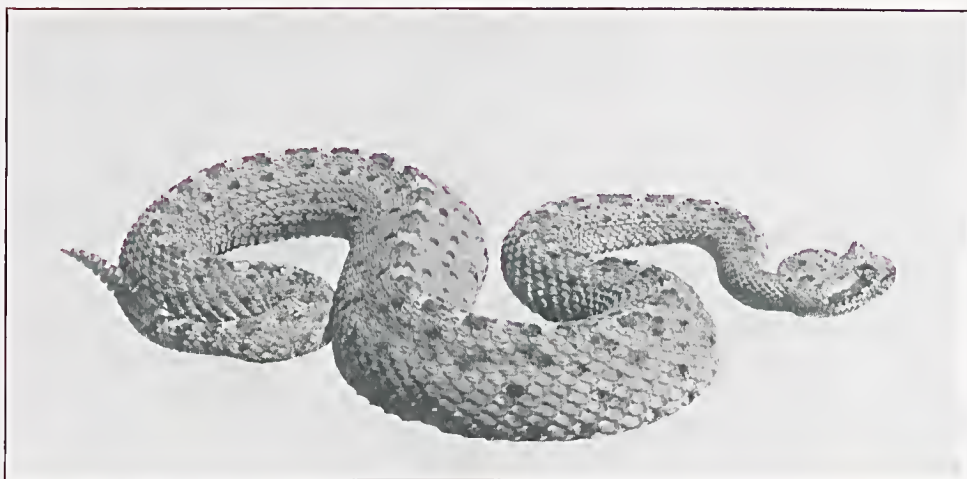


Fig. 18. The Sidewinder or Horned rattler (*Crotalus cerastes*). Maximum size $2\frac{1}{2}$ feet (0.75 m.)—Photo by Klauber.

California through Southern California to Southern Utah, and Southwestern Nevada and south into Arizona. It feeds on lizards and occasionally on rodents.

Crotalus tigris (Fig. 19), the Tiger Rattler, has about the same range as the Sidewinder, namely, Southern California, Southern Nevada and Arizona, but seems to feed on rodents only.

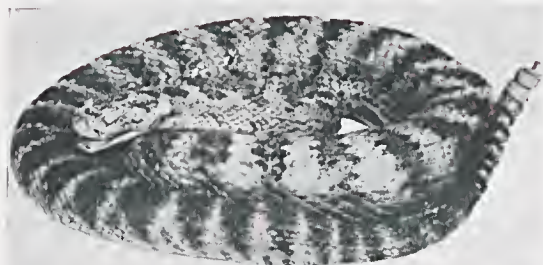


Fig. 19. The Tiger rattler (*Crotalus tigris*). Maximum size $2\frac{1}{2}$ feet (0.75 m.). (Copied from Plate 113, Van Denburgh's "Reptiles of Western North America," by permission California Academy of Sciences)



Fig. 20. The Green rattler (*Crotalus lepidus*). Maximum size 2 feet (0.60 m.)



Fig. 21. The Spotted rattler (*Crotalus triseriatus*). Maximum size over 2 feet (0.63 m.). Copied with permission from plate 119 of Van Denburgh's "Reptiles of Western North America."

Crotalus lepidus (Fig. 20), the Green Rattler, is found in the mountains from West Texas, South New Mexico and Arizona and the adjacent territory in Mexico. Very scanty information is available on the feeding habits of this species, but it seems to take mice and lizards very readily.

Crotalus triseriatus (Fig. 21), called the Spotted Rattler, is a small species confined to the mountains of Southern Arizona and the central plateau of Mexico, and feeds on lizards. In the United States, this species has heretofore been incorrectly called *Crotalus pricei*.

Crotalus willardi (Fig. 22), is another small species and has heretofore only been found in the mountains of Southeastern Arizona.

Besides *Crotalus terrificus*, the Neotropical Rattler, there are perhaps a few more forms of

striking in any direction. In captivity, however, it becomes tame very rapidly.

The Cotton Mouth Moccasin attacks everything that moves about it; it first widely opens its mouth and then strikes in any direction from which it perceives danger. The common name is taken from the fact that its mouth is whitish within, thus contrasting very noticeably with the color of its body, which is rather dark or blackish.

Of the Rattlers, the species of the West Coast seem to be the least irritable, as Klauber recently pointed out in the following paragraph:

"It is probable that there is as much difference in temperament among the individuals of any one species of rattlesnake as found in this area, as there is an average difference between the several species. All four local species seem to be relatively inoffensive. Invariably they



Fig. 22. Willard's rattler (*Crotalus willardi*). Maximum size $1\frac{1}{2}$ feet (0.45 m.). Smallest of all rattlers. (Copy of Plate 117, Van Denburgh's "Reptiles of Western North America," by permission California Academy of Sciences)

rattlesnakes, numbering about two or three, all of which are confined to the Lower California region. Their status, however, is not yet very clear, so that they do not deserve special mention in this paper.

BEHAVIOR OF POISONOUS SNAKES

The behavior of the Nearctic poisonous snakes varies widely according to the species considered. As a rule, our Coral Snakes are tame, whilst the Pit-vipers are more or less excitable. Both *Micrurus fulvius* and *M. euryxanthus* have secretive habits and usually do not bite unless hard pressed by some one unaware of their venomous nature.

The Copperhead is a rather vicious snake, which gives no warning of its presence while in the open, as it moves very suddenly and begins

attempt to escape, and I have yet to experience in the field an instance of a snake adopting an offensive attitude. While some individuals will put up a fight when cornered, their actions are apparently entirely defensive. Those found moving are usually more ready to fight than those which are coiled and resting. Some individuals will not even attempt a defensive fight and may be roughly handled without showing the least disposition to bite, or even rattle. *C. mitchellii* ordinarily exhibits a somewhat quicker readiness to fight than the others. *C. exsul* is very definitely the least offensive, and in this differs considerably from its nearest relative, *C. atrox atrox*. On only two occasions have I observed specimens of *C. exsul* to give notice of their presence by rattling before being disturbed; in both cases, in fact, they would have been passed by had they not rattled. There is, of course, no way of estimating how many hundreds of snakes I have passed closely in the field which have saved themselves by making no sound. In two cases recently I have found rattlers by hearing the characteristic "click" which they make when drawing themselves into a defensive coil, but without rattling. One of these was a specimen of *C. exsul*, the other, *C. mitchellii*.

Next to the Western Rattlers comes the Northeastern species, that is the Pigmy and the Timber Rattlers, in regard to which Ditmars has recently expressed the following opinion:

"Near and frequent contact with humans appears to have influenced the habits of our eastern reptiles. They usually keep close to sheltering holes or crevices, and when disturbed seek to escape as quickly as possible. Or they may try other tactics and remain quite motionless with the idea of the intruder passing them by unnoticed. They are not nearly so vicious or apt to strike as the poisonous reptiles of the southerly latitudes. Accidentally stepped on or touched by the hand of the careless climber, they will instantly bite, as they are extremely nervous. They are to be seriously reckoned as a hazard these days of hiking, camping and auto picnicking, as the great majority of our growing legions of outdoor enthusiasts are quite devoid of woodcraft."

The two Southern Rattlers, *Crotalus adamanteus* and *C. atrox*, are by far the most excitable and most vicious of all the Nearctic reptiles.

truded—a common movement among all serpents when irritated. Just before the blow the snake makes a hissing sound, which is caused by the act of expiration, and is due to the passage of air through the narrow glottis. It is louder in certain innocent serpents than in the *crotalus*.

"The mechanism of the forward cast of the body, which next occurs, is a very simple matter. The muscles which lie upon the convexity of the bending formed by the upper part of the snake are suddenly and violently contracted, so as abruptly to straighten the body, and thrust it forward in a direct line. The force resulting from this motion is not very great, as I have often ascertained when a snake has struck the end of a pole which I was holding, nor could it alone suffice to bury the fang in a tough skin were it not for the acts which follow and aid it. In effecting this forward thrust of the head and neck, the serpent employs only the upper part of its body, and consequently is unable, under any circumstances, to strike at a greater distance than one-half its length, while usually its projectile range does not exceed a third of its length. An impression prevails that when the snake lies coiled its head is raised very high to enable it to strike downward. It seems, however, to be of no moment in what direction the danger threatens, since it



Fig. 23. Posture assumed preparatory to striking. The Texas rattler (*C. atrox*) in three positions

Of their behavior the best description that has ever been printed is that of S. W. Mitchell, which I shall quote in full as it appeared in his memorable work on Rattlesnake Venom, now out of print:

"When the Rattlesnake is in repose and unmolested, it sometimes lies at length, sometimes coiled or wrapped fold on fold in the loops formed by other snakes which may happen to be in the same box. So soon, however, as cause is seen for alarm, the snake extricates itself, if among others, and at once throws its body into the coil so familiar to any one who has seen serpents, whether venomous or not. Sometimes on the edge, more often in the center of the coil, the tail projects far enough to admit of its vibrating freely and with singular swiftness. The head is raised a little above the rest of the body, but not usually more than 3 or 4 inches, even in large snakes. The neck and upper end of the trunk are not thrown into complete circles, but lie in two or three abrupt curves across the mass of the coiled body. The snake is now in position to strike. While thus at bay, in an attitude of singular grace, the long black tongue is frequently pro-

can at will cast itself forward, downward, or almost directly upward."

In regard to the direction of the coil, I have observed that in most of the cases, these rattlesnakes, upon being excited, coil up in such a way as to leave the left side of the body inside of the coil until it comes close to the neck which is doubled into an S-shaped loop. This loop is just what permits of their thrusting the head forward. In some cases, as often happens with the Western Diamond-back Rattler when it is very angry, it gradually raises its head well up in the air from 10 to 15 inches or more from the ground, according to its size, as seen in Fig. 23. Under these circumstances, it does not strike upward, but sideward or downward. However, when it is lying coiled, its head resting somewhere on its body, it can strike almost vertically upward, as the thrust often times forms an angle of nearly 70° with the underlying ground.

PREVENTION OF SNAKE POISONING

Snake poisoning with all its dreadful consequences, can be prevented in two ways, first, by avoiding snake bites; and, second, by applying a specific treatment against the effects of the bite.

1. *Prevention of snake bites*

Various means have been developed for the prevention of snake bites and they can be

poisonous snakes are inflicted on one's feet or legs (Fig. 24), it is simply a matter of common sense for one to wear shoes and heavy leggings (Fig. 25) to achieve the necessary protection, whenever one goes into a snake-infested district.



Fig. 24. Illustrating common method by which snake-bite is inflicted



Fig. 25. Puttees or boots offer effective protection against bites on the lower extremities

grouped into two main types of measures aiming respectively at (a) individual protection, and (b) collective protection.

(a) *Individual protection*.—Since it is known that, according to the different districts considered, from about 60 to 90 per cent of the bites of

In this respect, a few poisonous snakes must be considered separately. The bites of the Copperhead and of the Timber Rattler, for instance, are sometimes inflicted on one's hands, because both of these snakes live on ledges and so may be encountered in the path of one who is trying to

climb a rock, using his bare hands in order to help the ascension. In this case, therefore, the best thing for one to do is to avoid the use of his hands in order to climb where these venomous snakes may be found.

In the case of the Cotton Mouth Moccasin and the Florida Diamond-back Rattler, both of which live in marshy places, the conditions of the bite are also somewhat different. Since these snakes can reach as high as the thigh of one who is trying to negotiate a marsh or a stream, the best protection is afforded by a pair of rubber wading boots going up to the hip. Sometimes, as in the particular case of the Florida Rattler, that is known to grow to enormous proportions and have very long and strong fangs, it is advisable for anybody who wants to walk through swamps, to allow the upper part of the rubber wading boots to hang down over the knees, thus leaving an extra space between the two layers of rubber. In this way, if the rattler happens to strike the person, his fangs cannot go through the two thicknesses of the boot.

For most species, however, of poisonous snakes in this country, a pair of leather puttees, besides the shoes, will give one almost perfect protection against snake bites.

(b) *Collective protection.*—Collective protection is secured chiefly through the extermination of venomous snakes. This may be done by several methods grouped in the following way: 1. By systematically killing venomous snakes; 2. by capturing the snakes alive; 3. by raising animals that feed on snakes. Let us consider these methods briefly.

1. For many years past a few countries have tried to get rid of snakes by systematically killing them. In India, the British officers have sought to diminish snake poisoning by encouraging the killing of snakes and paying a fixed bounty for each head brought in. Despite all efforts in this direction, the British authorities have not been very successful in their campaign, as, after the work of several years, the death rate from snake bites in India seems not to have been reduced. As a matter of fact, complete extermination of snakes is impossible, unless all traces of jungle, forests, rocks, marshes and other haunts are removed. Moreover, the destruction of poisonous snakes can never be achieved in agricultural countries, primarily, because such snakes feed chiefly on rodents, the number of which increases with the development of agricul-

ture, and, secondarily, because both snakes and rodents follow the very well-known biological law applicable to all animals, that is, the more they feed the more young they bear.

2. Capturing live snakes seems to be a much more successful method of combating snake bites, because by taking away poisonous snakes from their habitat, we automatically remove one danger; and also by keeping the snakes alive, we can secure a supply of venom that may be used in the preparation of Antivenins or anti-snake-bite serums. This has been done in Brazil for



Fig. 26. Use of the hook in capturing venomous snake; not recommended for the inexperienced

over twenty years, and on a small scale in this country since the summer of 1926, with very encouraging results.

One can capture live poisonous snakes by using a wire hook, a leather lasso or even a forked stick made, for instance, of a branch of a tree. As shown in Fig. 26, the wire hook, which is adapted to the end of a long pole, must be thick enough not to bend while pressing the head of the snake against the ground. By pressing the snake head tightly, we can grasp it by the neck and put it into a sack, bag or box in which to transport it.

The leather lasso (Fig. 27) consists of a leather loop that slides freely through a metal keeper which is adapted to a long pole, the opening of the loop being guided by a long piece of wire operated by the capturer of the snake. The way venomous snakes coil, upon being disturbed, helps their capture, as, after coiling, they put up their heads towards the person approaching them. At that moment the operator can easily make the



Fig. 27. Use of the lasso in capture of venomous snake. This is the safest method for ordinary use

snake head come into the loop, and, as soon as this is achieved, he can tighten the loop around the neck and then lift and place the snake in a box or bag or some other receptacle, in which to send it to a place where it can be made use of.

The Antivenin Institute is glad to receive any venomous snakes that may be sent to it to be used in the preparation of Antivenin. At the Central Laboratory, as well as at the various Stations of this Institute, the venom is extracted from all snakes received and purified in such a way as to be used in the immunization of animals from which we secure the curative serum.

3. Raising animals that feed on snakes is a method that never succeeds in practice. A few of the Lesser Antilles have imported the Mon-goose with a view to exterminating the local snakes. This animal, although clever enough to escape being bitten, is perhaps more fond of poultry than of snakes, so that it has of late become a nuisance to the countries that have imported it.

The raising of snakes that kill other snakes (ophiophagous species) is a still less satisfactory method on account of the difficulties involved. Such species as the Black snake (*Coluber constrictor*) and the King snake (*Lampropeltis getulus*) that are known to be fond of other snakes, are of no avail in practice on account of the fact that they usually find something else to feed on. In this respect, it can be said that whenever people have tried to break the rules or change conditions of Nature, the results have not always been encouraging.

2. Specific treatment of snake poisoning

In regard to the administration of Antivenin, in case of snake bite inflicted by North American snakes, the Antivenin Institute of America recommends the following treatment.

If you do not have the Antivenin with you, everything depends upon carrying out the following procedure (1 and 2) promptly.

(1) Apply a ligature or tourniquet above the bite. This should be applied tightly at first, but must be partially released for a few seconds at five to ten minute intervals so as to maintain the necessary circulation in the limb. There is no particular advantage in making an incision nor in applying permanganate of potassium solution or crystals, or any of the other chemical agents commonly recommended for this purpose.

In fact, it is advisable to avoid any further mutilation or injury of the affected tissues, especially because, should the wound not be kept properly dressed until complete recovery, tetanus or other secondary infection might set in and complicate the patient's condition. In regard to potassium permanganate, it has been shown that, in order to have any effect on the venom, this substance must be used in concentrations that are injurious to the tissues. It has no effect in weak solution and is in itself toxic if used in strong solutions.

Above all, avoid the use of alcohol or any stimulant of that kind. These by strengthening

the circulation, may tend to help the distribution of venom throughout the body. Strychnine or caffeine however, may be used if symptoms of weakness and giddiness develop.

(2) Proceed at once to the nearest place where the Anti-Snake-Bite Serum and medical attention can be obtained.

Remember that the North American snake venoms are usually slow in acting and that, if the Antivenin can be obtained within 12 to 24 hours after the bite, the chances of its being effective are good. Of course, the earlier it is used, the more completely effective it is, and the quicker the recovery from the ill effects. Meanwhile, the ligature or tourniquet should be kept in place, but care should be taken to release pressure at intervals. Otherwise, congestion in the limb due to prolonged binding may favor initiation of gangrene. Release the tourniquet as soon as the serum is injected.

If you have Anti-Snake-Bite Serum with you at the time of the accident, do not apply tourniquet or bandage, but proceed immediately as follows:

(3) If medical aid is available the Doctor will inject the Antivenin. If no physician is at hand, the following directions should be followed carefully:

The Serum for the Nearctic Crotalidae (rattlesnakes, copperhead and moccasin) is a concentrated Antivenin. It is now supplied in North America in 10 cc. syringes with a needle and accessories, all sterilized and ready for instant use. In order that the package may be as small and as convenient to carry as possible, this injecting outfit is not completely assembled, but supplied in three parts (Fig. 28). The serum is in the syringe barrel (A), sealed off from all possible contamination by the rubber stopper in the small end of the syringe, and by the plunger plug near the wide end. Separate from this are the piston rod (C) and the glass-encased double-end needle, with stylet (B). These parts may be put together and the syringe made ready for injection (Fig. 29) within thirty seconds. No sterilizing or other preliminaries are necessary.

To assemble the syringe, (a) insert threaded end of piston rod through the opening in the metal-capped cork and screw it into the plunger plug, then give it a turn to loosen the plug a little, so that it will move easily when the injection is made. (b) Remove the shorter glass cap (S) and insert this end of the needle through the

center of the rubber plug at the small end of the syringe, which should first be wiped off with an antiseptic. (c) Leave the glass cap protecting the longer or injection end (i) of the needle in place until ready to make the injection. This protects the sterile needle from contamination. When this glass cap is removed it withdraws the stylet with it.

The Antivenin can be self-administered if necessary, in the same manner as a diabetes patient treats himself with Insulin. Injections may be made under the skin of the thigh, or, preferably, on the side of the abdomen, if applied

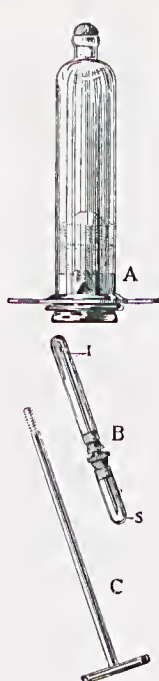


Fig. 28



Fig. 29.

Syringe of Antivenin as it comes from the package, and as assembled and ready for injection

by the victim himself. They should be given under the skin of the back, between the shoulders, if applied by some one else.

If the serum can be given at once or within the first hour or two after the bite, a portion of the syringe contents (2 to 3 cc, for instance) should be given by subcutaneous injection locally around the bite. This tends to prevent local destruction of the tissues. In late treated cases the local application is probably of little avail.

Then proceed as follows: First, cleanse the site of injection with soap and water, if available, and apply a suitable antiseptic, such as Tincture of Iodine, which should always be a part of the

first-aid kit. When this has been done remove the glass cap from the needle. Hold the syringe in a vertical position (Fig. 29), with the needle point upward, and slowly advance the plunger until all air is expelled from the needle and a drop of serum appears at the point.

At the previously cleansed site of injection pinch up the skin between the thumb and finger of the left hand, holding the syringe in the right hand parallel to the surface. Insert the needle

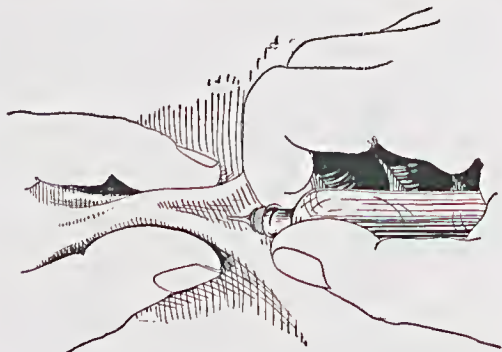


Fig. 30. Illustrating method of subcutaneous injection

with a firm, quick thrust (Fig. 30). The needle should be inserted nearly to its base, but the tip should be loose between the skin and underlying muscle. The left hand is now used to hold the syringe steadily, while, with the right hand, the piston is gradually advanced and the serum injected slowly. Upon completion of injection, withdraw the needle carefully and wipe off the surface with a little antiseptic.

If medical aid is available, intramuscular in-

jections are preferable, in order to hasten the absorption of the serum, and in cases seen late and those in which the symptoms are severe, intravenous injection is advised.

Dosage.—As each syringe contains 10 cc. of the Antivenin, inject the entire contents in one dose. The relation of the age of the person bitten to the dosage, is just the reverse of the usual rule for dosage. The amount of venom injected is the same whether a child or an adult is bitten. *The smaller the individual the greater the need of the Antivenin.* The syringe contains enough Antivenin to protect against the average amount of venom secreted at one time by North American serpents. *Where there is reason to believe that the poison injected by the serpent was of unusually large quantity, or when the symptoms develop quickly and in severe form, as, for instance, in children, it is advisable to give a second, third, or even a fourth dose if indicated; that is, if the first has not caused the symptoms of poisoning to subside. In all cases the patient should be watched for three to five hours after every injection, and if his condition has not improved within that time, a second injection, should then be made.*

Final remarks.—The snake-bite problem is distinctly a rural one and is assuming more and more importance in the United States, with the development and extension of agriculture and with the increase of touring, camping and other phases of outdoor life. Not only agriculturists, tourists, campers, hunters and fishermen, but also those engaged in railroad and other construction work, and in quarries, are definitely exposed.

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19. THE ANTI-SNAKE-BITE CAMPAIGN IN TEXAS AND IN THE SUB-TROPICAL UNITED STATES¹

BY AFRANIO DO AMARAL

Snake-bite poisoning is a subject which has been practically neglected in most countries, even in those in which poisonous snakes abound, the United States being no exception to the rule. Nowhere in the world can one find accurate statistics of snake-bites. It is needless to say that even the few progressive districts in the tropics, which have well organized agencies for the collection of public health statistics, have not endeavored to tabulate their cases of bites by poisonous snakes in a general comprehensive way. This may be partly due to the fact that there is no special classification assigned to snake-bite poisoning in the international list of causes of death. For this reason, it is practically impossible, from a study of available statistics, to make any computation of cases, fatal or non-fatal, that may occur in a given region.

In this country, until recently, nobody seemed to have the least idea of the frequency of cases of snake-bite. Less than five years ago, in Circular No. 571 of the Bureau of Biological Survey, United States Department of Agriculture, the following statement appeared: "The average mortality from bites of the American venomous snakes is a little more than 10 per cent, but due to infrequency of bites, fatalities are extremely rare. Death from the bite of a rattlesnake is an event of so rare occurrence that press reports of it appear as first page paragraphs in nearly every State of the Union." This statement seems to be based on Dr. P. Willson's (1) study of snake poisoning in this country, which is obviously out of date. Indeed, Dr. Willson found, on a study of 740 cases of bites by poisonous snakes of all kinds in this country, as reported in the medical literature or elsewhere, that the mortality was 78 cases, or 10.5 per cent. An analysis of his statistics, however, will show that he gathered but a negligible number of records of bites occurring in the south and southwest, that is, in the region where the most aggressive and venomous snakes are found.

Through the educational campaign which has been carried on by the Antivenin Institute of

America, many facts in regard to the incidence of snake-bites all over the United States have been brought to light, and appear to show that, contrary to the general opinion, snake poisoning is a much more frequent cause of death than is generally supposed. Many reports received through our stations in the south and southwest for the last year seem to fully justify this statement.

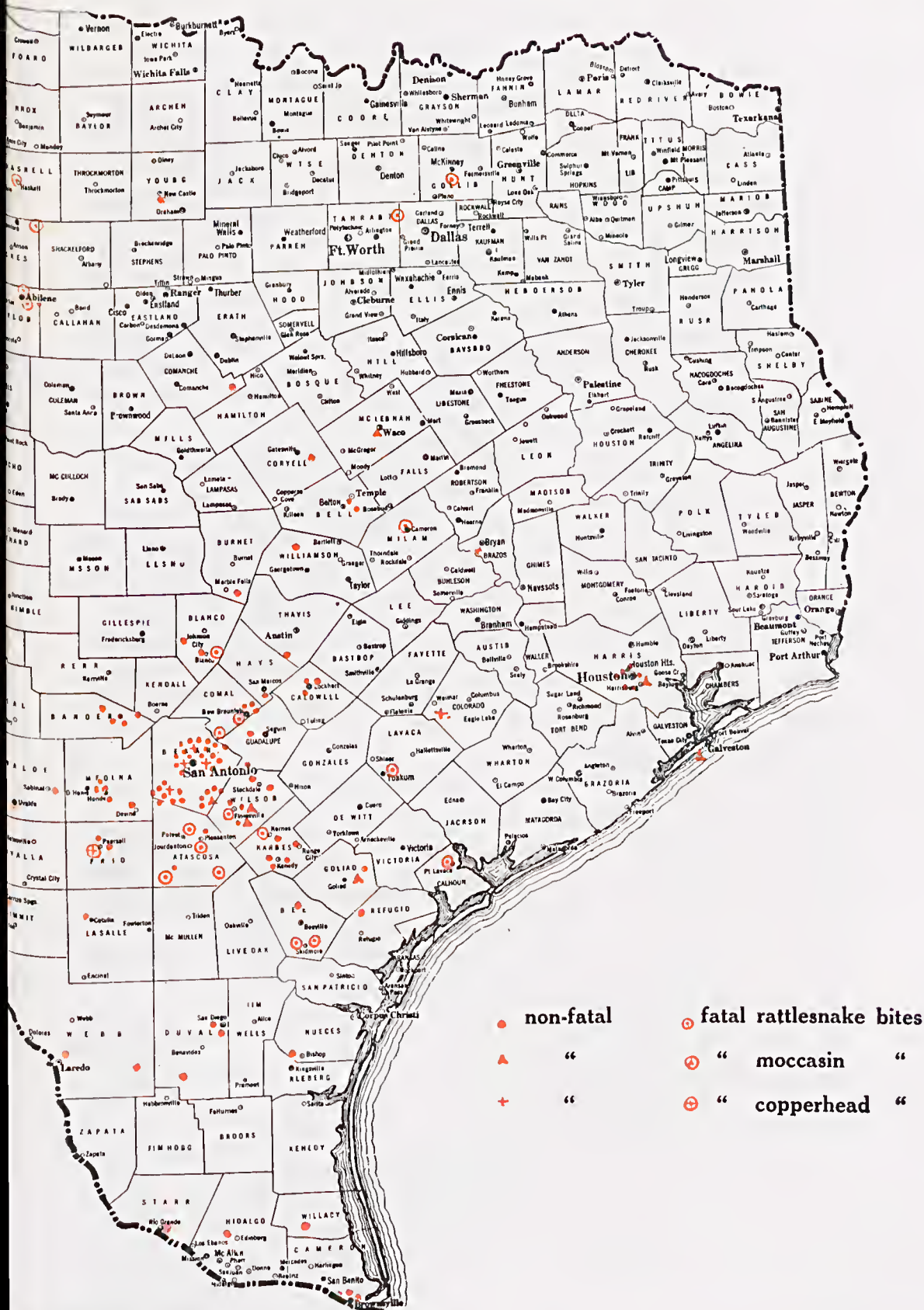
In Texas, especially, where the Antivenin Institute of America maintains its largest station, a careful survey of the situation has been made possible through the efforts of our assistants, army officers, medical men and others interested in the problem. In order to study the snake-bite problem in all of its aspects, the San Antonio (Texas) Station was organized in June of 1926, with Col. M. L. Crimmins, U. S. Army, retired, in charge as field assistant, and Major R. E. Scott, M.C., U. S. Army, as laboratory assistant. As a result of the campaign conducted by the station we have obtained data on 150 cases of bites by poisonous snakes that have occurred in Texas between July, 1926, and June, 1927 (12 months). As shown in the accompanying map, over 50 per cent of these cases were reported from Bexar County and the surrounding districts of south-central Texas. A glance at the map will immediately impress one with the thought that the news of the availability of the specific treatment has not yet spread to all of the distant counties in Texas, especially those of the north and northwest, where venomous snakes are particularly numerous. Despite all efforts made by the assistants of the station and by various army medical men who have tried to help them in their enthusiastic and humanitarian campaign, comparatively few cases of bites in the northern section of Texas were reported. Incomplete as they are, these statistics bring out the following facts:

1. Snake-bites in Texas occur any where—in desert districts, in cultivated fields, in woody places, about streams and marshes and near and even inside of houses.

2. Rattlesnake bites are by far the most numerous.

3. The people do not seem to be accustomed

¹ Read before the American Society of Tropical Medicine, Boston, Mass., October 21, 1927.



July, 1926 to June, 1927

yet to wearing shoes and leggings, so that most of the bites occur on the lower extremities.

4. Bites of the upper limbs are most frequent in young children.

TREATMENT OF CASES

In order to observe the effects of the antivenin in cases of snake-bite in Texas, the San Antonio Station traced serum that was used in the majority of the 150 cases reported in Texas between July, 1926, and June, 1927. As Col. Crimmins wrote, in an earlier issue of this Bulletin (2), up to September, 1926, antivenin had been used on 21 cases of rattlesnake bite and two of copperhead bite, with the result that all of these cases recovered, whilst out of 30 cases of rattlesnake bite in central Texas who were not treated with serum, 13 died.

In many instances, army airplanes were resorted to with a view of hurrying antivenin to patients living in distant localities that had no satisfactory roads or lacked other means of communication. Major Scott, who did most of the flying, has expressed his satisfaction as to the way the antivenin has acted in those cases.

I must, however, emphasize the fact that during the first year of our campaign, owing to the comparative scarcity of antivenin, this was reserved for the grave cases, that is, for those who showed the most severe symptoms of poisoning, either local or general.

In regard to the first-aid treatments applied in Texas, our assistants have found much difficulty in convincing people not to use kerosene oil, whiskey, potassium permanganate and other so-called snake-bite remedies, all of which are devoid of any action whatsoever on snake poisoning.

Another drawback we have found in our work everywhere in the States lies in the practice many people still have of applying the old method of scarification or incision of the tissues affected by the venom. This sort of treatment is unnecessary and expensive as it usually means hospitalization and may indeed have very serious consequences, as was the case with two patients—one in San Diego, Texas, the other in Belton, Texas—both of whom, after having completely recovered from the snake poisoning and returned to their homes, contracted tetanus through the wounds resulting from the incisions, and died in spite of all efforts made by the attending physicians.

The ideal method of treatment consists in administering Antivenin as soon as possible, in proper dosage, and in not touching the site of the bite. Early administration is now possible because antivenin is put out in syringes ready for immediate use.

Tables I and II, which deal with cases of bites reported in Texas during the period July, 1926, to June, 1927, show that out of 67 cases in which antivenin was not applied, 23 died, the death rate being 34.3 per cent.

As shown in Tables III and IV, in the July, 1926—June, 1927, period, antivenin was given in 83 cases of bites, with 78 recoveries and 5 deaths, giving a death rate of only 6 per cent. An analysis of Table IV shows that of the 5 deaths which occurred among serum-treated cases, 3 were of children. Two of these were given antivenin too late, after other methods of treatment had failed, and one in which antivenin was given in insufficient dosage. The two remaining cases, both adult patients, were also treated late and did not respond to the treatment.

In order to avoid repetition of the lamentable occurrence of young children being given insufficient doses of antivenin, we have of late issued special instructions along with every package of antivenin, including the following statement:

Dosage. Each syringe contains 10 cc. of the antivenin. Inject the entire contents in one dose. The age of the person bitten has no bearing on the dosage, because the amount of venom injected is the same whether a child or an adult is bitten. *The smaller the individual the greater the need of the antivenin.* The syringe contains enough antivenin to protect against the average amount of venom secreted at one time by North American serpents. Where there is reason to believe that the poison injected by the serpent was of unusually large quantity, or when the symptoms develop quickly and in severe form, as, for instance, in children, it is advisable to give a second, third, or even a fourth dose if indicated, that is, if the first has not caused the symptoms of poisoning to subside. In all cases the patient should be watched for three to five hours after every injection, and if his condition has not improved within that time, a second injection should then be made.*

The collation of the various cases in which serum treatment was given has been immensely facilitated through the courtesy of many physicians who have returned case records on the

*The above statement also appears in another article on "Nearctic Poisonous Snakes and Treatment of their Bites," published in this issue of the Bulletin, but its importance warrants the repetition.—Eds.

TABLE I
REPORTED CASES OF SNAKE-BITE TREATED WITHOUT ANTIVENIN
44 non-fatal

County	Town	Snake	Patient	Part of body bitten	Where and how patient was bitten
Ataseosa	Charlotte	Rattler*	M. T., girl, 6 years	Right hand	Not reported
Ataseosa	Lytle	Rattler	C. C., girl, 6 years	Not reported	Trying to locate something "that sounded like a locust"
Bandera	Pipecreek	Rattler	E. W.	Not reported	Not reported
Bexar	Elmendorf	Rattler	M. N.	Not reported	Not reported
Bexar	Elmendorf	Moccasin†	M. W., girl	Not reported	Not reported
Bexar	Ft. Sam Houston	Rattler	Mexican boy	Not reported	Not reported
Bexar	Maedona	Rattler	C. U., girl, 3 years	Middle right finger	Playing at home
Bexar	San Antonio	Rattler	T. G., girl, 16 years	Not reported	Not reported
Bexar	San Antonio	Rattler	J. G.	Not reported	Not reported
Bexar	San Antonio	Rattler	A. U., woman	Not reported	Pulling hay from a stack
Bexar	Somerset	Copperhead‡	D. B., boy, 10 years	Not reported	Playing near dead tree
Blanco	Blanco	Rattler	T. M., woman	Not reported	Not reported
Brazos	Bryan	Rattler	O. F. B., woman	Leg	Picking grapes in home yard
Brewster	Alpine	Rattler	T. M.	Not reported	Not reported
Burnet	Marble Falls	Rattler	F. S., boy, 14 years	Not reported	Not reported
Caldwell	Loekhart	Rattler	Girl, 16 years	Not reported	Not reported
Colorado	Weimar	Copperhead	C. G., boy, 6 years	Not reported	Not reported
Comanche	Lamkin	Rattler	Little girl	Not reported	Not reported
Coryell	Gatesville	Rattler	? M.	Not reported	Not reported
Dimmit	Carrigo Springs	Rattler	M. L. B., girl, 7 years	Not reported	Picking flowers
Duval	San Diego	Rattler	H. E.	Not reported	Not reported
Frio	Pearsall	Rattler	Woman	Not reported	Not reported
Galveston	Galveston	Moccasin	L. R.	Not reported	Not reported
Goliad	Fannin	Moccasin	C. R. C.	Not reported	Not reported
Guadalupe	Marion	Rattler	H. B.	Not reported	Not reported
Harris	Magnolia Park	Rattler	C. S.	Not reported	Not reported
Jefferson	Brooks	Rattler	H. G. U.	Right hand	Searching for supplies under counter
Karnes	Runge	Rattler	D. D., woman	Not reported	Not reported
La Salle	Cotulla	Rattler	E. M.	Not reported	Not reported
Medina	Devine	Rattler	L. C.	Not reported	Not reported
Medina	Hondo	Rattler	P. H.	Not reported	Not reported
Pecos	Ft. Stockton	Rattler	W. D.	Not reported	Not reported
Pecos	Ft. Stockton	Rattler	A. I. D., woman	Not reported	Not reported
Taylor	Abilene	Rattler	? J.	Not reported	Not reported
Terrell	Sanderson	Rattler	G. L., man	Not reported	Not reported
Travis	Creedmor	Rattler	Miss C.	Not reported	Not reported
Val Verde	Del Rio	Rattler	J. H. H.	Not reported	Not reported
Williamson	Andiee	Rattler	W. T., boy, 10 years	Not reported	Gathering fruit in peach orchard
Wilson	Floresville	Rattler	J. B.	Not reported	Not reported
Wilson	Floresville	Rattler	V. G.	Left ankle	Hunting rattlers
Wilson	Floresville	Moccasin	E. S.	Right hand	Hunting alligators and snakes, picked up moccasin by mistake
Wilson	Floresville	Moccasin	V. T.	Not reported	Not reported
Wilson	Lavernia	Rattler	M. F.	Not reported	Not reported
Wilson	Lavernia	Rattler	J. E. J.	Not reported	Not reported

* "Rattler" in these tables is represented by *Crotalus atrox*.

† "Moccasin" in these tables is represented by *Agkistrodon piscivorus*.

‡ "Copperhead" in these tables is represented by *Agkistrodon mokasen*.

TABLE II
REPORTED CASES OF SNAKE-BITE TREATED WITHOUT ANTIVENIN
23 fatal

County	Town	Snake	Patient	Part of the body bitten	Where and how patient was bitten
Atascosa	Campbellton	Rattler	P. C., boy	Not reported	Not reported
Atascosa	Jourdanton	Rattler	C. S., 2 years	Right hand	Playing in yard of his home, picked up snake
Atascosa	Poteet	Rattler	J. R.	Not reported	Not reported
Bandera	Bandera	Rattler	Mexican boy	Not reported	Not reported
Bee	Skidmore	Rattler	Z, girl, 8 years	<i>Labia majora</i>	Urinating in woods
Bee	Skidmore	Rattler	Boy, 2 years	Not reported	Not reported
Blanco	Blanco	Rattler	Mexican	Not reported	Not reported
Blanco	Hye	Rattler	C. H., boy, 18 months	Left leg	Playing in potato field
Calhoun	Port Lavaca	Rattler	C. LaB.	Not reported	Not reported
Collin	McKinney	Rattler	E. L. B., woman	Not reported	Not reported
Fisher	Sylvester	Moccasin	H. F. M.	Leg (5 times)	While fishing
Goliad	Goliad	Rattler	? Carroll	Not reported	Not reported
Haskell	Rule	Rattler	Man	Not reported	Not reported
Jones	Stamford	Rattler	J. F.	Not reported	Not reported
Lavaca	Yoakum	Rattler	J. D., 30 years	Shoulder	Hunting squirrels and seated on log
Lynn	Tahoka	Rattler	A. E. S., boy, 8 years	Chest	Walking in cultivated field
Milan	Cameron	Rattler	W. C., boy, 11 years	Foot (twice)	Picking fodder in field
Tarrant	Grapevine	Rattler	M. W.	Not reported	Not reported
Taylor	Abilene	Rattler	C. J., boy, 16 years	Not reported	Not reported
Taylor	Abilene	Rattler	E. J. T.	Not reported	Not reported
Taylor	Tuscola	Rattler	B.	Not reported	Not reported
Val Verde	Del Rio	Rattler	R. deL., boy, 14 years	Right hand	Hunting rabbits in burrow
Wilson	Floresville	Rattler	M. M., man	Not reported	Not reported

TABLE III
REPORTED CASES OF SNAKE-BITE TREATED WITH ANTIVENIN
78 recoveries

County	Town	Snake	Patient	Part of body bitten	Where and how patient was bitten	Intervals between bite and injecting antivenin
Atascosa	Lytle	Rattler	J. A., boy, 6 years	Not reported	Not reported	
Atascosa	Lytle	Rattler	I. G.	Not reported	Walking near home at night	3 hours
Atascosa	Pleasanton	Rattler	O. C.	Left ankle	Walking through watermelon patch	
Bandera	Bandera	Rattler	Mrs. C.	Not reported	Not reported	
Bandera	Bandera	Rattler	Baby	Not reported	Not reported	
Bandera	Medina	Rattler	M. C.	Not reported	Not reported	
Bee	Normanna	Rattler	F.H., boy, 13 years	Leg	Picking water-melons	
Bell	Belton	Rattler	N. V., boy, 6 years	Thumb	Gathering dew-berries	4 hours
Bell	Belton	Rattler	R. H., boy, 12 years	Right ankle	Not reported	
Bexar	Atascosa	Rattler	A. F. P.	Second finger of right hand	Lifting fruit jar under house	2½ hours
Bexar	Cassin	Rattler	R. C., boy, 3 years	Not reported	Not reported	

TABLE III—Continued

County	Town	Snake	Patient	Part of body bitten	Where and how patient was bitten	Intervals between bite and injecting antivenin
Bexar	Converse	Rattler	H. S., boy, 10 years	Middle finger left of left hand	Watching field mice play	
Bexar	Elmendorf	Rattler	J. Z.	Left ankle	Not reported	4½ hours
Bexar	Losoya	Rattler	J. M.	Not reported	Not reported	
Bexar	Macdona	Rattler	B. B.	Not reported	Stepping from front door of home at night	3 hours
Bexar	San Antonio	Rattler	J. C., boy, 16 years	Finger of right hand	Cutting weeds near home	
Bexar	San Antonio	Rattler	R. D., boy, 13 years	Calf of leg	Hunting rattlers	
Bexar	San Antonio	Rattler	M. F., girl, 2 years	Right leg	Playing in city park	
Bexar	San Antonio	Rattler	C. S.	Right leg	Not reported	3 hours
Bexar	San Antonio	Rattler	G. W., boy, 14 years	Palm of right hand	Not reported	
Bexar	San Antonio	Rattler	J. W. R.	Not reported	Not reported	
Bexar	San Antonio	Rattler	F. J.	Left ankle	Stepping out of porch at night	
Bexar	San Antonio	Rattler	A. B., girl, 13 years	Right heel	Coming from swim in creek	45 minutes
Bexar	San Antonio	Rattler	M. H.	Left leg	Shooting doves in pasture	
Bexar	San Antonio	Rattler	T. H., girl, 13 years	Left foot (3 times)	Putting chickens under shelter	2 hours
Bexar	San Antonio	Copperhead	A. B. S.	Left ankle	Walking in back yard of his home	12 hours
Bexar	San Antonio	Copperhead	E. N., boy, 3 years	Right index finger	Not reported	4½ hours
Bexar	San Antonio	Rattler	J. H., boy, 11 years	Right ankle	Not reported	1 hour
Bexar	Somerset	Rattler	G. G., boy, 8 years	Left foot, through thin leather boot	Walking in ranch	
Bexar	Southton	Rattler	L. S.	Not reported	Not reported	13 hours
Bexar	Von Ormy	Rattler	J. V., boy, 6 years	Right foot	Playing in field	1½ hours
Bexar	Wetmore	Rattler	M. A. G., negro girl, 11 years	Not reported	Not reported	
Caldwell	Lockhart	Rattler	Girl, 2 years	Not reported	Not reported	
Caldwell	Maxwell (Springs)	Rattler	D. G., girl, 3 years	Middle finger of left hand	Not reported	
Cameron	Brownsville	Rattler	Boy, 9 years	Not reported	Not reported	
Cameron	Brownsville	Rattler	B. Z.	Not reported	Not reported	
Cameron	Brownsville	Rattler	N. E.	Not reported	Not reported	
Comal	New Braunfels	Rattler	C., Mexican boy	Not reported	Not reported	5 hours
Comal	New Braunfels	Rattler	A. Z., girl	Not reported	Not reported	
Comal	New Braunfels	Rattler	Mexican boy	Not reported	Not reported	
Dimmit	Carrizo Springs	Rattler	R. McK., 48 years	Right thumb	Working in cultivated field	5 hours
Duval	Realitos	Rattler	J. A. M., 35 years	Right leg	Not reported	13 hours
Duval	San Diego	Rattler	B. A., 28 years	Right leg	Not reported	1 hour
Frio	Pearsall	Rattler	A. C., boy, 6 years	Left ankle	Not reported	3 hours, and 24 hours

TABLE III—Continued

County	Town	Snake	Patient	Part of body bitten	Where and how patient was bitten	Intervals between bite and injecting antivenin
Glasscock	Garden City	Rattler	C. C., boy, 6 years	Right ankle	Not reported	2 hours
Harris	Houston	Rattler	Girl, 10 years	Not reported	Not reported	
Harris	Houston	Rattler	H. N.	Right hand	Not reported	
Harris	Houston	Rattler	B. R.	Not reported	Picking peas in garden	
Harris	Houston	Rattler	Woman	Not reported	Not reported	
Harris	Houston	Rattler	B. W.	Not reported	Not reported	
Harris	Houston	Moccasin	Not reported	Not reported	Not reported	
Hays	San Marcos	Rattler	A. B., boy, 5 years	Thumb of right hand	Not reported	20 minutes
Hidalgo	Edinburg	Rattler	H. A., boy, 3½ years	Not reported	Not reported	8 hours
Karnes	Karnes City	Rattler	E. S., boy, 11 years	Not reported	Not reported	½ hour
Karnes	Kenedy	Rattler	J. L. S., woman	Right index finger	Working in her living room	5 hours
Karnes	Kenedy Junction	Rattler	J. A., boy, 11 years	Right ankle	Not reported	4 hours
Karnes	Kenedy Junction	Rattler	J. C. W., boy, 11 years	Not reported	Not reported	24 hours
McLennan	Waco	Moccasin	Little Boy	Not reported	Not reported	
Maverick	Eagle Pass	Rattler	J. R.	Not reported	Not reported	28½ hours
Maverick	Eagle Pass	Rattler	Boy	Not reported	Not reported	
Medina	Hondo	Rattler	E. B., boy	Ankle	Walking in pasture	
Medina	Hondo	Rattler	H. B., boy, 18 months	Between fingers of left hand	Playing in yard of his home	
Medina	Hondo	Rattler	A. J. H., woman	Above right eye	Sleeping on porch	2 doses, 50 minutes and 4 hours
Medina	Hondo	Rattler	Negro girl	Not reported	Not reported	1 hour
Nueces	Bishop	Rattler	C. E. A.	Not reported	Not reported	12 hours
Starr	Rio Grande City	Rattler	E. C.	Not reported	Not reported	
Sterling	Sterling City	Rattler	L. C., girl, 5 years	Finger of right hand	Not reported	22 hours
Terrell	Dryden	Rattler	G. L.	Not reported	Not reported	30 hours
Uvalde	Sabinal	Rattler	Man	Not reported	Not reported	
Uvalde	Uvalde City	Rattler	J. D., girl	Hip	Not reported	½ hour
Valverde	Dullis	Rattler	W. MeA.,	Not reported	Not reported	
Valverde	Del Rio	Rattler	M. R., boy, 4 years	Left leg	Not reported	2 hours
Webb	Laredo	Rattler	Man	Not reported	Not reported	
Webb	Mirando City	Rattler	J. S. D.	Not reported	Not reported	
Willacy	Raymondville	Rattler	Mexican woman	Hand	Not reported	
Wilson	Floresville	Rattler	Little girl	Not reported	Not reported	½ hour
Wilson	Stoekdale	Rattler	L. W. F.	Not reported	Not reported	
Young	Newcastle	Rattler	M. I., boy, 4 years	Not reported	Not reported	About 24 hours

TABLE IV
REPORTED CASES OF SNAKE-BITE TREATED WITH ANTIVENIN
5 fatal

County	Town	Snake	Patient	Part of body bitten	Where and how patient was bitten	Remarks
Ataseosa	Davistown	Rattler	W. P., boy, 18 months	Right hand	Playing in yard of his home	Medical and serum late
Comal	Bracken	Rattler	S. R., woman, 28 years	Left leg	In field picking corn	Medical and serum late
Comal	New Braun- fels	Rattler	Woman	Not reported	Not reported	Antivenin late
Frio	Pearsall	Copperhead	T. A., boy, 14 years	Little finger of right hand	Hunting rabbit in burrow	Medical and serum late
Karnes	Hobson	Rattler	J. D., boy, 6 years	Above ankle	Not reported	Insufficient dosage

forms provided for that purpose with each syringe of antivenin. The form reads as follows:

Name of person bitten.....Age.....
Resident of.....
State of.....
Circumstances under which, and place where, the bite occurred.....
.....
Part of the body which was bitten.....
Date of the accident:
Hour.....Day.....Month.....Year.....
Name of the snake responsible*.....
What time elapsed between the bite and the injection of the Antivenin (Serum)?.....
What was the dose of Antivenin injected?.....
What other treatment or first-aid was applied before or after serum injection?.....
What was the result of Antivenin treatment?.....
Cure?.....
Underseore which of the following symptoms were noted, and give your observations on the effect of the Antivenin treatment in the space under Remarks, below.
Pain; Swelling; Hemorrhage; Paralysis; Gangrene; Giddiness; Weakness; Heart failure; Shortness of breath.
Was the Antivenin administered by a physieian?.....
By a non-medical companion?...By the victim himself?...
Remarks.....
.....
Signature of the physician or of the person reporting.....
.....
Date.....Address.....

* Whenever possible, the name should give, as accurately as possible, the species of the snake; for example: "Texas diamond-back rattler (*Crotalus atrox*)," or "Timber rattlesnake (*Crotalus horridus*)," etc.

In spite of the difficulties encountered during the initial phase of our campaign, we are grati-

fied with the favorable results obtained with the serum treatment, as compared with the figures collected of those cases that were not treated with serum. Now that antivenin is being produced on a much larger scale and is being distributed commercially throughout the various snake-infested districts, we hope to secure more complete information as to the incidence of snake-bite in Texas and in the United States in general.

SNAKE-BITES IN OTHER SUB-TROPICAL DISTRICTS

Outside of Texas, snake-infested districts have not yet responded so enthusiastically. Of the Gulf states, Florida is the only one that has already sent in fairly complete reports of the cases observed. Although we have known, through newspaper clippings, of quite a few cases in Mississippi, Alabama and Louisiana, yet between May and September of this year we received only eight clinical reports from that section. This, however, is not at all surprising, as even in California where we maintain a station, very few people seem to be willing to send in reports of snake-bites observed there, as during last summer we received reports of only five cases, two of which were fatal.

In conclusion, we look forward to the time when, with the gradual increase in the production and distribution of the antivenin and the wider dissemination of the newer knowledge of our poisonous snakes and the treatment of their bites, there will be no more deaths from snake-bite in this country.

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20. STUDIES OF NEOTROPIC OPHIDIA

VIII. *TRACHYBOA* PETERS, 1860

By AFRANIO DO AMARAL

The reptiles and amphibians of Central and South America are, as every herpetologist knows, still very incompletely known. Barbour (1) has justly pointed out that no recent publications satisfactorily list the reptilian fauna of more than small areas. The writer has for some time realized personally the necessity of revision, as the best, not to say the only, publication which deals in a general comprehensive way with the snakes of the neotropic region is the Catalogue of the British Museum. This work was published by Boulenger between 1893 and 1896, and is now somewhat antiquated in several respects.

But before the goal of a general revision can be attained in a fairly satisfactory way, we must first know more about the ophiological representation of a great many more districts scattered through this immense zoögeographic zone. As to the species of snakes which occur, for instance, in most of the Central American countries, as well as in Venezuela, Colombia, Ecuador, Peru and even in Brazil, much remains to be done before we can claim to be in a position to pass judgment on their respective features and relationships.

With these considerations in mind, I have, for the last six or seven years, tried to make a revisionary study of all collections of neotropic snakes to which I have had access, and to undertake this study from the most diverse angles, such as taxonomy, anatomy, biology and immunology. These endeavors have already been recorded in a series of papers published in various scientific journals and periodicals. Of course, I am aware of the fact that these studies are of little help to those who, not being thoroughly familiar with the ophiologic fauna of the American tropics, would rather have keys that would simplify the work of identification when they come across specimens from that zone. With the hope of meeting this need, I have started a series of systematic revisions of all genera of neotropic snakes with a view to arranging them with keys and eventually publishing them in a general monograph. The first study of the latter series—No. 1 of my "Studies of Neotropic Ophidia"—has already appeared in the Proceedings of the New England Zoological Club, Vol.

IX, 1924. It deals with the genus *Helminthophis*.

The second revisionary study, dealing with the genus *Trachyboa*, is the subject of the present paper.

The genus *Trachyboa* was first described by Fischer in 1860 (2), and until recently was monotypic, as it contained only the type species, *gularis*, originally represented by two specimens, both of which were collected at Guayaquil, Ecuador.

In 1861, Jan (3) figured this species, based on one specimen in the Hamburg Museum and said to have been received from Brazil, which information does not seem to be absolutely accurate.

In 1893, Boulenger (4) redescribed the genus *Trachyboa* and its type, without adding any further information to Fischer's original definition and Jan's figure.

In 1898, Boulenger (5) referred to a specimen received from Paramba, Ecuador, and differing from Jan's figure in having the orbit completely surrounded by 14 scales, the upper labials being excluded therefrom. Its formula was

$$\text{Sc. 29} \\ \text{V. 142, C. 27}.$$

In 1905, Rosén (6) described another specimen from Balao, Ecuador, as having the orbit surrounded by 11 scales and 2 upper labials (the 6th and 7th) and the formula

$$\text{Sc. 31} \\ \text{V. 146, C. 29}.$$

This specimen was considered to represent a new variety named *multimaculata*, as it showed three series of small spots on each side of the dorsum, instead of two, as found in Boulenger's redescription of the typical form. However, I consider the character assigned to *multimaculata* by Rosén as devoid of any particular significance, because in Jan's figure of *gularis* there are shown 3 series of dorsal spots, although the 2 upper ones are very faint.

In 1910, Peracca (7) added a second species to the genus, when he described and figured *Trachyboa boulengeri*, based on one specimen contained in the collection of the Zoological Museum of the Royal University of Naples, and having

$$\text{Sc. 33} \\ \text{V. 139, C. 22}.$$

The type locality of

T. boulengeri was not known, but Peracca wrote that it came from tropical South America, a very vague statement indeed.

There are, therefore, two species representing the genus *Trachyboa*, viz., *gularis* from Ecuador and *boulengeri* from an unknown locality.

Very recently I found a second specimen of the latter in a collection received from Colombia by the United States National Museum. This specimen was taken in the region of the Rio San Juan, Provincia de Choco, in the western part of Colombia, thus affording an opportunity to settle such an important point as the zone in which *T. boulengeri* is found. Having examined the Colombian specimen very carefully, I am now in a position to confirm all of Peracca's findings, except that concerning the vestiges of hind limbs, which the Italian author gave as non-existing in his specimen. He stated: "L'unico esemplare é indiscutibilmente un maschio e non presenta traccia di rudimenti esterni di estremità posteriori, presenti invece nell'unica specie nota del genere, nel *Tr. gularis* Ptrs." In the specimen No. 72,354, in the collection of the United States National Museum, the spur-like vestiges of the hind limbs are very clear on both sides of the vent.

Range.—Until a definite statement is recorded confirming their occurrence in the Brazilian territory, we must consider the representatives of this genus as living in humid, very warm, woody and rather low districts about the equatorial line, their range, as far as we know it now, covering but a small area comprised between the Pacific Ocean and the western slope of the Andes of Ecuador and Colombia.

Size.—Neither *gularis* nor *boulengeri* seem to attain any considerable size, as a maximum length recorded for the former is 395 mm., in Fischer's type specimen *a*, and 371 mm. for the latter, in Peracca's type.

Redescription.—In the light of our present knowledge, we can redescribe the genus *Trachyboa* and its two forms as follows:

Trachyboa Peters, 1860

Vestiges of hind limbs present. Maxillary and mandibular teeth very slightly decreasing posteriorly; palatine and pterygoid teeth present, subequal. Head slightly distinct from neck, covered with keeled scales; rostral

either absent or very reduced vertically; nasal entire. Eye moderate, pupil vertically elliptic, body short and compressed laterally. Scales keeled without pits. Tail short, prehensile (?); subcaudals single.

T. gularis Peters, 1860

Snout scarcely prominent. Upper head scales small, convex keeled, a few on the snout transversely enlarged and smooth; orbit surrounded or not by one or more labials besides several scales; 4 pairs of shields bordering the mental groove. Dorsal scales strongly keeled in 29 to 31 rows. Ventrals 142-152; anal entire; subcaudals 25-30.

Brown above, darker on the top of the head and the middle of the nape; one series of faint spots along the vertebral line and two alternating series of black spots on each side, the lower more marked, larger and extending down to the belly, which is yellowish.

Distribution.—Lowlands of Western Ecuador; Brazil(?).

T. boulengeri Peracca, 1910

Snout scarcely prominent; rostral very low nearly linear, transversely placed; rostral region occupied by 5 small tuberculated shields, the uppermost pair bearing a horn-like process; nasal entire; internasals compressed laterally in a horn-like process; side of snout and top of head with small rough scales; orbit surrounded by numerous scales, the 2 uppermost (supraoculars) compressed laterally and raised in a horn-like process; 10 to 12 upper labials, all rough, those close to angle of mouth more or less tuberculated; symphyseal very wide and low, nearly linear; 4 pairs of chin-shields around mental groove, all tuberculated; gulars also tuberculated. Scales in 33 rows, all more or less strongly keeled from neck to tip of tail. Ventrals 132-139; anal entire; subcaudals 22, single.

Chocolate brown above with irregular yellowish blotches on middle of dorsum, and with 5 series of black spots, 2 on each side and one on the vertebral line; head dark brown, lips yellow and brown anteriorly, brown posteriorly; under surface light yellowish pink with 2 series of large black spots or cross-bands irregularly arranged; tail light brown with black dots above, yellowish, nearly immaculate below.

Distribution.—Lowlands of western Colombia (Rio San Juan).

Key to the species

The following key may be used in the differentiation of these two species:

1. top of head without horns.....*gularis*
2. top of head with a few small horns.....*boulengeri*

I wish to express my appreciation of the assistance received in this study from Miss Helene M. Robinson, secretary to Dr. T. Barbour, of the Museum of Comparative Zoology of Harvard University.

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X 21. STUDIES OF NEOTROPIC OPHIDIA

IX. ANOMALEPIS JAN, 1861

BY AFRANIO DO AMARAL

Since Jan in 1861 (1) described *Anomalepis*, after he had figured the type species *mexicana*, in 1860, no herpetologist seems to have studied this interesting genus more carefully than did Dunn in 1923 (2). Bocourt (3) has been the only author besides Jan, to figure it. Upon close examination, however, Bocourt's figure is seen to be an exact copy of Jan's.

Boulenger in 1893 (4), on the assumption that Jan had not examined the dentition of *Anomalepis*, placed this genus with the *Glauconiidae*¹ instead of with the *Typhlopidae*, thus following Garman's views (5). Garman, however, was not accurate when he stated that *Anomalepis* had teeth in the lower jaw, because, as Dunn has already shown, in the same paper in which he made this statement the genus was mentioned by Garman himself as having teeth in the *upper* jaw.

Having examined the three specimens of *Anomalepis mexicana*, studied by Dunn in 1923, all of which came from Perico, Department of Jaen, Peru, and are now in the collection of the Museum of Comparative Zoology, and also one specimen from the Panama Canal Zone, obtained at Frijoles in 1924 and now in the collection of the Field Museum of Natural History, I am able to confirm Dunn's findings in this respect. There is no doubt that the genus *Anomalepis* must be assigned to the *Typhlopidae* because it has no ectopterygoid, its maxillary is toothed and its mandible edentulous.

Now, with regard to Jan's figure of *A. mexicana* and the copy that appeared in Bocourt's publication, I find that the head shields are very inaccurately represented. In a recent paper (6), I showed likewise that the head shields of *Helminthophis flavoterminalis* were not accurately represented in the drawing made by Sordelli for Fasc. I, pl. VI, fig. 10, of Jan's *Iconographie Générale*. This drawing was very sharply criticized by Peters (7) in 1862.

The case with *Anomalepis mexicana* appears to be the same, because, having compared Jan's figure with the 4 above-mentioned specimens, I

have found the following differences from the first published figure:

The nasal (Fig. 1) is figured as large, sub-divided and bordering the lip, so clearly that Boulenger, who apparently had never examined the type, considered this as characteristic of the genus. In reality, the nasal is not sub-divided and what was taken by Jan, Bocourt and Boulenger as a sub-division of this shield is the posterior part of the suture between the nasal and the first labial (Fig. 2). By examining carefully the head of this snake under the microscope with strong magnification, we can see that the naso-labial suture passes under the nostril and extends almost imperceptibly beyond it to the border of the rostral. Therefore, the nasal, instead of being large, sub-divided and bordering the lip, is rather small, undivided and widely separated from the lip by the first labial.



Fig. 1. *Anomalepis mexicana* (after Jan and Bocourt)



Fig. 2. *Anomalepis mexicana* (author's illustration)

Likewise, the number of labials is not 2, as stated by these authors. Dunn stated in his paper that there were 3 labials in the 3 Peruvian specimens he examined, but I have found them to be 4. The 4th labial is a small and narrow shield, lying right in the corner of the mouth and separating the 3rd labial from the cervical scales. It is present in all of the 3 specimens from Peru in the Museum of Comparative Zoology, as well as in the Panamanian specimen in the Field Museum of Natural History.

In regard to the preoculars, as found in Boulenger's description, one is the upper preocular, but the other is the loreal referred to by Dunn, so that the actual lower preocular was taken as the anterior sub-ocular by Boulenger.

The difference between my own findings and Jan's figure can be explained by assuming that

¹ Now called *Leptotyphlopidae*.

Sordelli in his drawing missed the naso-labial suture which is very difficult to discover, the last labial, which is very small, and two minute shields, sub-oculars that lie in an oblique line below and behind the ocular. In every other respect, the head scutellation of his figure agrees with that of the specimens I have examined.

Boulenger made no reference to the postoculars, which Dunn stated to be in the number of 3, although I have found only 2, in all of the 3 specimens he examined, as well as in the one from Panama.

In regard to body scales, which were given as 22 by Jan, Bocourt and Boulenger, I have found them to vary from 20 to 28, according to the different regions of the body. In the Panamanian specimen, for instance, No. 8224, Field Museum of Natural History, there are 24 rows around the neck and 22 everywhere else, although at a few points this number decreases to 21 or increases to 23, on account of occasional sub-division or coalescence of one or two of the median abdominal rows. In 2 of the Peruvian specimens (M.C.Z., Nos. 17401, 17403), there are 28 scales around the neck, 26 around the middle of body and 24 around the preanal region, although in No. 17402 (M.C.Z.) there are 26 anteriorly, 24 in the middle and 22 posteriorly.

The 2 pre-anals are placed more transversely across the vent in the Panamanian specimen than in the Peruvian ones; also the tail is shorter and more rounded in the former than in the latter, but this may represent only a sexual difference.

Based on this study, I am taking this opportunity to re-describe both the genus and its sole species as follows:

Anomalepis Jan, 1861

Ectopterygoid absent; maxillary toothed; mandible edentulous. Head covered with shields, of which a pair of prefrontals and a frontal, a rostral, a nasal, a loreal, 2 preoculars and one ocular are prominent. Pre-anal scales enlarged.

Anomalepis mexicana Jan, 1860 (Fig. 2)

Snout rounded, moderately prominent, nostrils lateral; rostral moderate; prefrontals and frontal subequal in size, the prefrontals forming a long suture behind the rostral; one supraocular well-developed; one ocular; 2 preoculars; one rostral rather small; one loreal, placed between the nasal and the first labial anteriorly, the preoculars posteriorly, and the 2nd and 3rd labials inferiorly; parietals represented by about 12 enlarged scales arranged in 3 longitudinal rows of 4 each; 4 labials, the first in contact with the nasal, the rostral and the loreal, the 2nd in contact with the loreal, the 3rd in contact with the loreal, the lower preocular and the anterior subocular, the 4th, very small, separated from the ocular by the sub-oculars and a small shield; 2 sub-oculars, small; 2 superposed post-oculars. Two enlarged pre-anals. The tail either broader than long or longer, according perhaps to the sex. The scale rows in the middle of the body—22, as in the type from Mexico and in the Panamanian specimen, or 24 to 26 in the Peruvian specimens.

Coloration.—Brownish above and lighter beneath or uniform dusky plumbeous with light-edged scales.

Dimensions.—The length of the type was given as being 130 mm., tail 5 mm.; No. 8224, Field. Mus. Nat. Hist., measures 155 mm., tail 3 mm.; No. 17,401, M.C.Z. = 153 mm., tail 3 mm.; No. 17,402, N.C.Z. = 177 mm., tail injured; No. 17,403, N.C.Z. = 158 mm., tail 3 mm.

Distribution.—As far as we know now, this species has been found in Mexico, Panama and Peru.

Note.—In case the variation in the number of scale rows and in the relative length and shape of the tail proves not to merely represent a sexual difference, the Peruvian specimens may form a separate race. The specimen I have examined from Panama does not seem to be distinct from the typical form.

The genus *Anomalepis* is closely related to *Helminthophis*, from which it can be distinguished easily by its comparatively small rostral, large pair of prefrontals and enlarged pre-anals.

As they are now known, the *Typhlopidae* are represented by four genera, which may be distinguished as follows:

- I. Pre-anal enlarged. *Anomalepis*
- II. Pre-anal not enlarged
 - A. Head with large shields
 - a. A pair of large prefrontals and a frontal; nasal small *Helminthophis*
 - b. Nasal very large, extending on the side of the rostral to the top of the head. . . . *Typhlops*
 - B. Head covered with small scales. *Typhlophis*

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Bulletin of the Antivenin Institute of America

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Edited by

THOMAS BARBOUR, R. H. HUTCHISON *and* AFRANTIO DO AMARAL

WITH THE COLLABORATION OF OTHER MEMBERS OF THE STAFF OF THE INSTITUTE

The BULLETIN contains scientific contributions to, and current information on, the relation of snakes and other poisonous animals to man, with special reference to the highly venomous species of North and Central America, the West Indies, and northern South America. The subject matter covers taxonomy, biology and geographical distribution of species; the economic and public health aspects of the snake-bite problem; the collection of venoms, their composition, properties, and physiological effects; the production of antivenins; and related serological and immunological problems.

Address all communications to the BULLETIN OF THE ANTIVENIN INSTITUTE OF AMERICA, Box 1404, Philadelphia, Pa.



ANNOUNCEMENT

When the Antivenin Institute of America was organized in 1926, it was understood that Dr. Amaral had obtained a two years extension of leave of absence—an extension generously granted by his government to permit Americans to benefit from Dr. Amaral's Brazilian experience.

With the approach of the end of the two year period, Dr. Amaral has received a call requiring his early return to his native country, to take up active direction of important work there.

It is a pleasure to announce that Dr. Amaral will retain his connection with the Antivenin Institute of America in the capacity of Consulting Director. The laboratory and production work will be carried along in the usual way by Dr. Thomas S. Githens, who has been working with Dr. Amaral for some months.

The changes made necessary in the editorship of this Bulletin will permit continuation of the publication on the same plane and with the same degree of scientific accuracy. Dr. Thomas Barbour, Director of the Museum of Comparative Zoölogy, Harvard University, has consented to act as editor and will devote special attention to technical and scientific questions. Dr. Amaral will continue as a member of the Editorial Board. It is anticipated that future issues of the Bulletin will include more and more articles on snake venoms, their antigenic properties, and on the immunological aspects and treatment.

The Antivenin Institute has recently expanded its organization to include, as it now does, a Mississippi Valley Station under the direction of Mr. George P. Vierheller of the St. Louis Zoölogical Park, and a Gulf States Station at New Orleans, La., under the patronage of Dr. Wm. Scheppegegrell. Through the generous coöperation of these Stations the field of usefulness for the Institute will be greatly increased.

22. FIELD NOTES ON BARBA AMARILLA (*BOTHROPS ATROX*)By DOUGLAS D. H. MARCH¹

Since taking up work at Tela, Honduras, soon after the establishment of the local station of the Antivenin Institute of America, in coöperation with the Tela Railroad Company and the Museum of Comparative Zoology of Harvard University, the writer has had opportunity to become fairly well acquainted with a number of the neotropical vipers in this region, more especially, with the "barba amarilla," the subject of these notes. This snake, also known under the common name of "fer-de-lance," and in some localities as "terciopelo," is the most important poisonous neotropical viper. It is quite abundant in Honduras, and on account of its habits and behaviour, it constitutes one of the serious hazards in the development of agriculture in the American tropics.

Tela lies on the north coast of the Republic of Honduras and is one of the principal ports of call for steamers of the United Fruit Company. The entire region thereabout constitutes a portion of the coastal plain, the elevation varying from that of sea level to about 130 feet. Tela is the headquarters of the Tela Railroad Company, which operates large plantations in the Ulua Valley. These plantations occupy the south bank of the Ulua River throughout the lower part of its basin. That part of the Ulua Valley which is east of the river and west of the Mico Quemado, Tiburon and Toloa Mountain ranges comprises about 200 square miles, of which approximately 40,000 acres are under cultivation. The rainfall, temperature and humidity of this region is that of the sub-tropical coastal plain.

The area which is not cultivated consists of woodland and flat, swampy jungleland, densely covered with an impenetrable undergrowth. Considerable field work was done in the San Alejo district—a wooded region where the continuity of the plain is broken by several small rivers, namely, the San Alejo, Santiago, the Innocente, and numerous smaller streams. The region is well watered, thickly overgrown, and affords abundant food and cover for small animals of all kinds, and naturally it invites snakes of all species. Conditions in this district seem es-

pecially favorable to reptilian life and some exceptionally large specimens of *B. atrox* were captured here.

Since establishing the Serpenterium, or "Snake Farm," and beginning systematic collection of snakes in this region, the writer's observations would indicate that *B. atrox* shows a tendency to abandon woodlands for the banana plantations, in spite of the fact that the nature of the uncultivated areas would theoretically favor a higher incidence of this species. The preference of snakes for the banana plantations is probably due to the fact that here the multiplication of forest and field rats, opossums, and other small animals is favored. Young opossums in this region seem to be the favorite food of the full-grown *B. atrox*, although a large snake of this species seems to have little difficulty in swallowing a full-grown opossum. The writer has taken a full-grown opossum from a snake of this species measuring 6½ feet.

It is doubtful whether the other species of this genus (*Bothrops*) so readily abandon the woodlands. Although there have been three cases of *B. schlegelii* poisoning treated at the Tela Hospital, this species and *B. brachystoma* are seldom met with by the working forces on the plantations. They are much smaller than *B. atrox* and are consequently benefited to a lesser degree by the abundance of small mammals in the banana plantations. I believe that *B. brachystoma* subsists almost entirely on lizards, and *B. schlegelii*, being semi-arboreal in habit, subsists on birds and lizards, although Dr. H. C. Clark, of the United Fruit Company, found a small opossum in a *B. schlegelii*. It is probable that cultivation is less likely to lead to a change of habitat of these species than would be the case with the larger snakes. However, we must admit a lack of accurate data bearing on these points.

Although there is unquestionably a higher incidence of *B. atrox* in the plantations than in the wooded districts, yet it is from the forests that I have received most of the specimens that have found their way to the "Snake Farm" or Serpenterium. This is due to the fact that, even during the cleaning period on the farms when weeds are cut down between the banana mats, the banana stalks themselves afford the

¹ From the Tela Station, Antivenin Institute of America, Tela, Spanish Honduras, C. A.

snakes sufficient cover to avoid detection. In new land work, however, everything is felled during the underbrushing except the largest trees, and the snakes, excepting those hiding in holes, are almost certain to be seen and either captured or killed. On the new land operations,

captured with little or no danger to the would be captor. In this connection, it is my opinion, without belittling or questioning the courage of the barba amarilla in any degree, that its aggressiveness has been somewhat exaggerated. In the Serpentarium, for example, they frequently



Fig. 1. The Snake Village near Tela, Honduras, maintained by the Antivenin Institute of America in coöperation with the Museum of Comparative Zoology, Harvard University, and the Tela Railroad Company. Headquarters for the collection of poisonous serpents of Central America

too, the overseers are in closer contact with the working gangs and, if interested in the work, can stimulate the killing or capture of snakes to an extent scarcely possible in the case of a producing farm where the overseer does not, except on infrequent occasions, meet the "mozos"² in large numbers.

In this connection, it is interesting to note that although more, and on the average larger, barba amarilla were captured in the uncultivated region of San Alejo than in the rest of the region combined, no one was bitten, whereas, on the producing farms there were several accidents, some serious, but fortunately none were fatal because serum was available in every case. This bears out the thought expressed above that the thoroughness with which underbrushing is carried out on new land operations is almost certain to bring snakes to light so that they are either captured or killed, while in the plantation work there are many hiding places where the snakes may remain undisturbed, and from which they may strike at passing objects. It also supports the contention that even the larger and more courageous venomous snakes, if intelligently approached, can be

strike at one in passing, but the only example of actual offensive tactics with which I am personally familiar occurred on a new land operation in Guaymas.

I had accompanied a gang engaged in underbrushing, and taking a position where I was



Fig. 2. The Serpentarium, where the collections of live snakes are kept

within hearing of the entire group, I heard a man call that there was a barba amarilla where he was working. Arriving at the spot I saw the snake lying very nearly at full length directly in front of where the man had been working. The brush had been cut to within 3 feet of where the snake

² Honduran laborer is called "Mozo."



Fig. 3. Interior of the Serpentarium, showing method of construction which prevents escape, and the array of small huts which offer a retreat

was lying without its having shown any sign of annoyance or being disturbed.

However, when I reached to draw the snake out with the bent rod I use for that purpose, instead of it retreating further into the bush where

captured the snake, one of the natives would certainly have dispatched it with a machete.



Fig. 4. Close-up of one of the snake huts with specimens of the "fer-de-lance" in the foreground

it had abundant cover, and an excellent chance of escape, it elected to come out into the open where I quickly pinned it down and captured it. I would have given it a chance to have carried its move to completion had there not been so many natives on the scene. Had I not immediately



Fig. 5. A fer-de-lance or barba amarilla (*Bothrops atrox*) at the opening of one of the huts

Everything that comes within reach of a machete goes down. The natives' readiness to use a

'machete on practically any creature that crosses his path has made my work here extremely difficult, inasmuch as one out of every three snakes delivered to me shows machete wounds.

The barba amarilla is ovi-viviparous and has astonishingly large broods. One killed at Progreso contained 64 young, one that died in the Serpentarium contained 65, and a newly captured specimen from the Guaymas District gave birth to 71, of which the record follows:

Bothrops atrox gave birth on September 25, 1927, to 71 young, 57 living and 14 dead. Snake was at full term



Fig. 6. The author giving instructions on the use of the lasso in the capture of a poisonous snake

or at least the young were quite well enough developed to care for themselves at once. It is quite probable that the number of other large snakes in the hut with the mother at the time she gave birth to her young may have crushed or smothered the 14 dead mentioned.

The mother snake was 6 feet and 7 inches in length (2.006 meters) and 4.3 pounds in weight (19,500 grams).

One of the living young was weighed at the end of 24 hours and showed a weight of 10.5 grams. One of the still-born young that had been in a formalin solution for 48 hours weighed 12 grams and measured 33 cm. (13.0 inches).

The 71 young weighed 745.5 grams (1.64 pounds), without the fetal membranes, etc.

The young snakes are equipped with very well developed fangs at birth and show a readiness to use them that is quite at variance with the cool watchful demeanor of the adult. Their extreme irascibility, along with their faculty of tree climbing, is responsible for the fact that far more plantation workers are bitten by these baby snakes than by the larger ones, and it should not be forgotten that the bite of one of these youngsters a few days or weeks after birth is



Fig. 7. The female barba amarilla (*Bothrops atrox*) referred to in text as mother of a brood of 71 young

very dangerous, as the following record (available through the courtesy of Dr. H. C. Clark, of the United Fruit Company, who treated the case) will show:

History: This man was cleaning out dead leaves and bushes that had collected during the dry season. He came to a banana mat that had, growing amongst its shoots, a bush somewhat higher than one's head. He struck the bush near its base to cut it down and the jar of the machete stroke caused a snake to be dislodged from the branches. It fell across his hat and face and in trying to throw it aside, it struck his left index finger. It required a vigorous swing of his arm to get the snake loose from his finger.

Very soon after the bite he began to expectorate bloody foam. He had chest pain and cramps and pains in abdomen of a severe nature. Could not stand on his feet for some hours afterward. He expectorated about a pint and a half of bloody sputum each twenty-four hours after admission to the Hospital until the third day. The next two days the sputum was pinkish in color and greatly reduced in amount. Owing to an obstruction on the railroad it was not possible to reach this man until 5 hours and 40 minutes after the bite when he was given 10 cc. of Anti-Bothropic Serum subcutaneously between the shoulders.

The young barba amarilla has a decidedly prehensile tail, and is quite arboreal in habit, but in captivity those exceeding $3\frac{1}{2}$ or 4 feet show little, or no inclination to climb. The new born snakes have bright yellow tails resembling very much the tails of young copperheads (*A. mokasen*).

The species is nocturnal and is frequently seen by men when hunting at night with lights and is also occasionally noted by motor-car drivers and passengers in the early morning hours.

There are many cases reported of these snakes killing cattle and mules, but the sources of these stories are in most cases notoriously unreliable, although I do know of one case where a cow was killed by a large *B. atrox*.

good cover for the snakes. A member of an engineering party was killed some years ago by a snake that struck him from the shelter of one of these holes. The men were travelling single file and the third man in the line was bitten and died in a very short time.

Although there are a few rocky ridges in the Division I have not, as yet, had any *B. atrox* from these places nor heard of their occurrence there. They seem to be confined almost entirely to the lower levels in this vicinity. In the interior of Honduras they may take to higher ground. Fallen trees and the accumulation of dead leaves at the base of manacca palms are favorite hiding places.

This snake does not raise the head above the

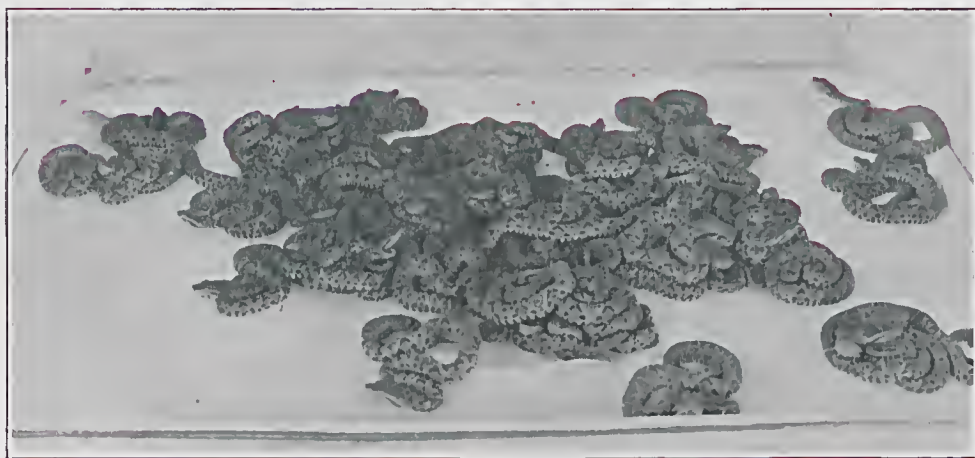


Fig. 8. A litter of young. See text, page 95

Bamboo thickets form admirable coverts, growing in very close order, so close in fact, that in most instances a man could not squeeze between the trunks. (I am writing this from what must be the snake point of view, as I do not believe there is an engineer or farmer in Honduras who sees anything admirable in bamboo.) Added to this feature are the thorny lower branches that aid in forming an impassable barrier that yields only to the axe. Here the barba amarilla and the mosquito are absolute masters of the situation. In the more open jungle they depend largely on the abandoned burrows of the agouti, paca, etc., and on so-called manacca holes from one to three feet in diameter, and of like depth, which are caused by the falling of the manacca or corozza palm and the decaying of the roots. These holes, when partly filled with fallen leaves and forest debris, afford

body in the manner of the rattler when about to strike. It seems to be able to deliver a blow from an extended posture as effectively as from a coiled one, and there is none of the strategic maneuvering of the rattlesnake. With some of the larger specimens one can completely circle the snake, and the only movement on the part of the snake will be to shift the head slightly. It seems to me to be very much more accurate in its striking than the "rattler," and its very calmness tends to make its opponent less wary, and to draw it within striking distance when, I think, the barba amarilla rarely misses.

It has, however, an army of enemies that show little respect for it, and of these I think the armadillo is chief. The armadillo will dig up snakes, and it makes no difference what kind. There is little doubt that the bulk of the snakes captured by the armadillo, pecarry, skunk, etc.,

must necessarily be slow terrestrial vipers, burrowing snakes and an occasional small boa. Hawks, herons and other birds also make serious inroads in the ranks of the young snakes.

We also have the "zumbadora" here. Known as the "mussarana" in Brazil, it is reputed to select only venomous snakes as its victims, but it is my belief that any heavy bodied snake other than its own species would be taken as readily as one of the poisonous kinds.

Other dangers to which they are exposed include fires and flood. Many of them are doubtless carried down the waterways on floating logs and trees and lost, but I think that fires in the tropics exact a much smaller toll of them than in the temperature climes where forest fires are more frequent and extensive, and where the first few inches of surface soil (organic matter) is usually involved. Even the pasture fires are unlikely to create so intense a heat as in the States,

because of the clumpy nature of the growth, consequently snakes in burrows or other holes are more likely to survive a fire than in countries where forage grasses form a sod and bring the fires much closer to the ground.

There is a great range in color of the barba amarilla which has little to do with size, although the very large individuals are invariably of very dark brown or blackish ground color with showy yellow markings. This phase is frequently met with in the smaller snakes, but in the majority they are subject to great variation. It is the large dark individuals that merit the name of barba amarilla (yellow beard), their chin being really yellow, while the half grown ones show all shades from dull white to pale yellow, they are never so brilliantly colored as the big fellows.

The photographs show the pattern as well as the characteristic yellow chin.

23. RATTLESNAKE VENOM ANTIDOTE OF THE HOPI INDIANS

By GEORGE E. COLEMAN¹

Much has been written of the fearlessness of the Hopi Indians of Arizona in handling rattlesnakes, and of their freedom from fatalities when bitten either during their snake dances or at other times. I was present at two of the snake dances last August and asked many questions of educated and intelligent Indians. The following statements were made to me by them: (1) Neither the fangs nor the poison glands of the snakes used in the dances are removed. (2) The Indians are occasionally bitten during the dance. One Indian Priest was bitten in the face last August at Walpi. They are occasionally bitten at other times. (3) There appears to be no natural immunity among the Indians to rattlesnake venom. (4) An antidote is prepared by boiling the leaves and stems of some plant the nature of which is kept secret. This secret is known to only one person in the tribe and when his death becomes imminent is handed down to another.

One Indian said the plant is boiled in water ten

minutes, another said half an hour and a third reported two or three hours. Many of the Indians are said to have this remedy constantly on hand and it is said to be effective for two or three months after being prepared. The usual procedures are adopted in cases of rattlesnake bite, that is, the application of a tourniquet when possible, and lancing of the wound. After this the wound is moistened with the antidote which is also taken internally.

I succeeded in securing a pint of this antidote said to have been freshly prepared. I was shown the approximate quantity taken, which when measured amounted to 50 cc. The Indian who gave me the remedy stated that only one dose is taken. I returned to California ten days later and placed the antidote in the ice box. Two months after receiving it various tests with dried rattlesnake venom were made.

The liquid was slightly turbid, of a pale amber color and without odor. It was acid (pH 5.09) and had a slightly bitter taste. Two cubic centimeters fed to a 350-gram guinea pig while fasting produced no visible symptoms during twenty-four hours. The animal was then killed

¹From the George Williams Hooper Foundation for Medical Research, University of California Medical School, San Francisco.

TABLE I
RATTLESNAKE VENOM AND ANTIDOTE

Guinea pig weight	Venom intramuscularly	Antidote various	Results
300 to 400 grams	1 cc. = 0.002 gram + 1 cc. NaCl (control)	October 19 None	Very severe lesions—recovered
	2 cc. = 0.004 gram + 1 cc. NaCl (control)	None	Death in 4 days
	2 cc. = 0.0004 gram + 1 cc. NaCl (control)	None	Swollen and dark—recovered
	2 cc. = 0.00004 gram + 1 cc. NaCl (control)	None	Very slight swelling—recovered
300 to 400 grams	1.5 cc. = 0.003 gram	October 20 1 cc. mixed 1 hour laboratory temperature	Death 4 days
	1.5 cc. = 0.003 gram	1 cc. injected site wound in $\frac{1}{2}$ hour	Very severe lesions—recovered
	1.5 cc. = 0.003 gram (control)	None	Death 31 hours
	None	2 cc. intramuscularly (control)	Greatly swollen and hard
300 to 400 grams	Solution of October 20 2 cc. = 0.005 gram	October 24 Fed 0.5 cc. immediately	Death 4 days
	2 cc. = 0.005 gram	Fed 0.5 cc. immediately	Death 17 hours
	None	Fed 1.5 cc.	No symptoms
		Fed 2 cc. same guinea pig November 3 (control)	Autopsy 24 hours—no lesions
300 to 400 grams white strain	1 cc. = 0.004 gram + 1 cc. NaCl	November 5 None	Death 22 hours
	1 cc. = 0.004 gram + 1 cc. NaCl	None	Death 22 hours—very ill 2 hours
	1 cc. = 0.004 gram + 1 cc. NaCl	1 cc. $1\frac{2}{3}$ hours laboratory temperature	Death 22 hours
	1 cc. = 0.004 gram + 1 cc. NaCl	1 cc. $1\frac{2}{3}$ hours laboratory temperature	Death 22 hours
	1 cc. = 0.004 gram + 1 cc. NaCl	1.5 cc. injected intramuscularly $\frac{1}{4}$ hour later	Death 22 hours
	1 cc. = 0.004 gram + 1 cc. NaCl	1.5 cc. injected intramuscularly $\frac{1}{4}$ hour later	Death 22 hours
Black guinea pig	1 cc. = 0.004 gram + 1 cc. NaCl	2 cc. fed 5 minutes later	Death 22 hours
	1 cc. = 0.004 gram + 1 cc. NaCl	2 cc. fed 5 minutes later	Death 2 hours
	1 cc. = 0.004 gram + 1 cc. NaCl	2 cc. fed 5 minutes later	Death 22 hours
220 to 250 grams, white strain	1 cc. = 0.001 gram	November 9 None	All animals died within 16 hours
	1 cc. = 0.001 gram	None	
	1 cc. = 0.001 gram	1 cc. mixed 1 hour laboratory temperature and $\frac{1}{2}$ hour at 36°	
	1 cc. = 0.001 gram	1 cc. mixed 1 hour laboratory temperature and $\frac{1}{2}$ hour at 36°	
	1 cc. = 0.001 gram	1 cc. mixed injected immediately	
	1 cc. = 0.001 gram	1 cc. mixed injected immediately	
	1 cc. = 0.001 gram	2 cc. fed immediately	
	1 cc. = 0.001 gram	2 cc. fed immediately	

TABLE I—Continued

Guinea pig weight	Venom intramuscularly	Antidote various	Results
220 to 268 grams, white strain	1 cc. = 0.0005 gram	<i>November 10</i> None	Moderately severe—recovered
	1 cc. = 0.0005 gram	None	Very severe—recovered
	1 cc. = 0.0005 gram	1 cc. mixed same as November 9	Very severe—recovered
	1 cc. = 0.0005 gram	1 cc. mixed same as November 9	Death 17 hours
	1 cc. = 0.0005 gram	1 cc. mixed injected immediately	Death 40 hours
	1 cc. = 0.0005 gram	1 cc. mixed injected immediately	Very severe—recovered
	1 cc. = 0.0005 gram	Fed 2 cc. immediately	Moderately severe—recovered
	1 cc. = 0.0005 gram	Fed 2 cc. immediately	Moderately severe—recovered

and the esophagus, stomach and ileum were normal in appearance. The amount fed was per body weight about 3 to 4 times the amount said to have been the dose for a 150-pound man. Two cubic centimeters injected into the leg muscles of a guinea pig produced within twenty-four hours intense swelling with lameness. The area about the puncture became indurated for two or three days. Within a week the leg was normal and the lameness had disappeared.

A study was then made of the possible neutralizing effect of this "antidote" against dried rattlesnake venom. The venom used was old and had not been kept in vacuo. The dried venom was freshly weighed and dissolved for each experiment. Guinea pigs were used in the experiments and injections were made into the leg muscle. The antidote and saline solution of the venom were mixed and allowed to stand at laboratory and incubator temperatures for one to one and one-half hours before injection. In another series injections of the antidote were made into the area receiving the venom shortly afterwards or it was mixed with the venom and injected immediately. Another series of animals were fed the antidote very shortly after the

venom was injected. The results of these experiments are shown in table 1.

It will be noted that in the experiments beginning November 5 in which a different strain and somewhat younger guinea pigs were used the animals proved to be far more susceptible to the venom. There are also differences in susceptibility in animals of the same weight.

SUMMARY

While admitting that only a few guinea pigs were used it is apparent from these experiments that the "antidote," at least two months after its preparation, does not protect guinea pigs against small amounts of rattlesnake venom. It should be noted, however, that no attempt was made to prevent the rapid absorption of the venom by the application of a tourniquet. On that account, and given possible differences in the susceptibility of guinea pigs and man to venom and antidote, the results are hardly comparable with those said to be obtained in the case of the Indians. The antidote certainly does not neutralize the venom in vitro.

Fresh antidote has been requested and if received the experiment will be repeated.

24. A NEW ELAPID FROM WESTERN PANAMA

By THOMAS BARBOUR and AFRANIO DO AMARAL

During part of 1925 and 1926 Captain Thomas H. Stewart, Jr., Medical Corps, U. S. A., was attached as medical officer to detachments of engineers mapping the little known hinterland of Western Panama. While camped in the high rainy mountains inland from the old settlement of Nombre de Dios, Captain Stewart made an interesting collection of reptiles which he kindly gave to the Museum of Comparative Zoology. He found *Micrurus mipartitus*, *Leptodeira annulata*, *Liophis decoratus*, *Ninia atrata* and the extremely rare *Tantilla semicincta*. Moreover, he had the great good fortune to find a most peculiar new Coral Snake. With this it is a great pleasure to associate Captain Stewart's name in recognition of his interest for several years in increasing our knowledge of the zoology of Panama.

Micrurus stewarti sp. n.

Type.—Female, No. 24,924 in the collection of the Museum of Comparative Zoology, collected in 1926 by Captain Thomas H. Stewart, Jr., M. C., U. S. A., inland

from Nombre de Dios, Serrania de la Bruja, Republic of Panama, approximate altitude 1200 meters, in deep rain-forest.

Description.—Eye about two thirds as long as its distance from the lip border. Rostral deeper than broad, the portion visible from above about half as long as its distance from the frontal; internasals small, half as long as the prefrontals; frontal twice as broad as the supraocular, once and one-third as long as broad, shorter than the parietals; parietals longer than their distance from the internasals; nasal divided, in contact with the preocular; 1 preocular; 2 postoculars; temporals 1 + 2; seven upper labials, third larger than fourth, third and fourth entering the orbit, seventh well developed; first pair of lower labials in contact behind the symphysial, four lower labials in contact with the anterior chin-shields which are slightly shorter than the posterior. Scales in 15 rows. Ventrals 197; anal divided; subcaudals 50 pairs.

Coloration.—Head black to the level of the eye, then yellowish red to the occiput; nape and neck with a broad black ring; body with 6 sets of double black rings, a broad followed by a narrow one, and each separated from the other by a narrow red ring with black-tipped scales; a red ring around the vent region; tail with 2 black and 2 red rings, tip black.

Total length, 380 mm.; tail 52 mm.

25. IMPROVED PROCESS OF VENOM EXTRACTION

By AFRANIO DO AMARAL

Of the various processes that have been developed for extracting venom from snakes, three deserve special mention, namely, that originated by Gouzien and published by Calmette in 1907 (1), that described in detail by Fitzsimmonds in 1912 (2), and that figured by V. Brazil in 1914 (3).

Calmette's process consisted in putting the snake in a large glass container, anesthetizing it with chloroform, holding it by the neck, opening its mouth and pressing with the fingers both the venom glands so as to empty them. The venom that is obtained is collected in a dish. It is then put in a desiccator over calcium chloride or sulphuric acid in order to dry so that it can be preserved for laboratory experiments.

Fitzsimmonds modified the above technic by covering the laboratory glass in which the venom is collected with thin glazed cloth or a

sheet of rubber, the former being preferable in his opinion.

V. Brazil, having had many more snakes to handle than any of his predecessors elsewhere in the world, described his process as follows: "The helper catches the snake with a lasso exactly behind its head. He takes off the lasso after having grasped the snake between his thumb and forefinger of right hand. Then he holds the snake body with his left hand, and with the right, he presents the snake's head to the operator. The latter holds the upper jaw of the snake with a clamp and slides a Petri dish under the fangs, so as to collect the venom as soon as the reptile bites (Fig. 1). Afterwards, the operator squeezes the poison glands so as to finish the extraction."

Having tried all these processes at various times I have become convinced that none is absolutely satisfactory when one has to extract venom from

many specimens and, at the same time, tries to avoid injury to the reptile's mouth. Calmette's

required to anesthetize many snakes. At the same time the snakes develop mouth infection (stomatitis) due to the fact that there is no



Fig. 1. Technic of venom extraction used at the Instituto Sorotherapico, Butantan, Sao Paulo, Brazil



Fig. 3. Technic of venom extraction formerly used at the Antivenin Institute of America, stage 2



Fig. 2. Technic of venom extraction formerly used at the Antivenin Institute of America, stage 1



Fig. 4. New technic of venom extraction now used at the Antivenin Institute. With this technic one person can carry out the entire operation

process, for instance, is too tedious as it takes too long to carry out, and is also very costly on account of the large amounts of chloroform

protection at the edge of the dish against injury of the mucous membrane or of the palatine teeth, which usually break off during the extrac-

tion. Fitzsimmonds' process is much better, although I personally do not favor the use of cloth wherewith to cover the receptacle because it absorbs some of the venom, thus decreasing its quantity. It also affords no protection against injury of the mucous membrane and the palatine teeth of the snake, and therefore does not prevent stomatitis and septicemia from developing after venom has been extracted a couple of times.

V. Brazil's method seems to be the best of the three when there are many snakes to be handled, although it does not avoid injury of the mucosa or the palatine teeth, which takes place virtually in all cases. As a matter of fact, the death rate of snakes undergoing venom extraction at the Butantan Institute has been so high that for the last few years I have been endeavoring to improve the technic in such a way as to handle many snakes in one day's work, yet at the same time prevent injury of their mouth. I first tried to avoid the injury of the snake's mouth by covering the laboratory glass with a sheet of rubber, the technic being as follows: An assistant would open the snake's mouth with his left hand, and while holding the laboratory glass with his right hand would induce the snake to bite through the sheeting. After that, the assistant would hold the glass and the operator finish the extraction by squeezing the glands so as to empty them, the venom being collected as shown in Figs. 2 and 3.

After trying this process many times I found that it still had some disadvantages, namely, that the amount of labor involved was unnecessarily high, due to the fact that two persons were needed to perform the extraction and also that injury of

the snake's teeth was not completely avoided. Then I decided to have a rubber ring placed around the mouth of the laboratory glass, which was then covered with a sheet of rubber, the glass being fastened on the table between two pieces of board. In this way the operator alone could easily carry out the process and avoid injury of the snake's teeth in most cases. Moreover, by using this method the operator proceeds with greater confidence and feels more secure as he does not have to trust anybody but himself nor does he have to watch anything else than the snake.

This technic, which has been standardized of late and used at the Snake House of the Antivenin Institute of America, may be described as follows:

A laboratory glass is fastened on a table, a rubber ring placed around its mouth and then covered with a sheet of rubber (rubberized cretonne). The operator catches the snake by the neck with his left hand; the reptile's body is held between the operator's thighs and the table (in case of small specimens the snake body is held under the operator's arm); by means of forceps held in the right hand the operator opens the snake's mouth and induces the reptile to bite through the rubber sheeting. Finally, both glands are compressed gently, gradually and simultaneously by the thumbs and the forefingers (Fig. 4).

This process permits of handling from 30 to 60 or more snakes per hour without much injury to them. This has been applied for over a year at the Central Laboratory of the Antivenin Institute and lately used in our station at Tela, Honduras, always with much success.

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26. STUDIES ON SNAKE VENOMS

I. AMOUNTS OF VENOM SECRETED BY NEARCTIC PIT VIPERS

By AFRANTIO DO AMARAL

It is well known that the amount of venom secreted at one time by a snake of the genus *Crotalus*, *Agkistrodon* or *Sistrurus*, varies greatly according to the size and age of the specimen, conditions under which it is kept, length of period of fasting and repose, etc. In regard to the first factor (size and age), it seems that in general the larger and older specimens secrete larger amounts of venom if they are kept under proper conditions.

In connection with the second factor (conditions of living), I have found that usually right after being captured snakes yield less venom than when they are properly kept in confinement and repose for two or three weeks. Feeding and fighting in their natural surroundings seem to greatly interfere with the amount of venom to be secured when the snake is first captured. Also, the amount of venom spontaneously injected by a snake at a bite is usually smaller than that which can be obtained by forcing it to bite and completing the operation by methodic and gradual compression of its glands. In regard to this, I have carefully measured the amount of venom ejected at a time by a snake by inducing it to bite through a rubber membrane placed on the top of a laboratory glass, as compared with the amount of venom secured, right after it has bitten, by emptying both of its glands through progressive and methodic compression of its temporal region. The figures thus obtained show very conclusively that a snake (genera *Crotalus* and *Agkistrodon*) never ejects the entire content of its glands when it bites. It always holds back or keeps part of its venom, apparently for the next bite, the amount excreted at first representing but 25 to 75 per cent (usually 50 per cent) of the total.

With respect to the third factor (period of fasting and repose), it is necessary to give the snake complete rest for at least two or three weeks and also avoid the presence of other snakes in the same cage previous to the venom extraction. For a snake to have its glands completely filled with venom it is necessary for it to be kept in a cage, in the dark, and absolutely undisturbed,

the temperature of the room not being below 60°F. or over 80°F., and the humidity not being below 50 per cent.

Moreover, as Weir Mitchell showed long ago, more venom may be extracted when the snakes are anesthetized so as to relax muscular resistance. Unfortunately, anesthetizing the snakes is a very expensive proposition when one has many specimens to handle. For this reason we have for some time tried to improve the technic used in extracting snake venom, in such a way as to avoid injury of the snake's mouth and at the same time obtaining as large a yield of venom as possible. The technic now used at the Antivenin Institute is described elsewhere in this issue of the BULLETIN.

RELATION BETWEEN DRIED AND LIQUID VENOM

The relation between dried and liquid venom varies greatly according to the snakes concerned. Observers do not seem to be in accord as to what proportion of the total weight of the venom is represented by the solid portion, but this may be due to errors in calculation, if not to the fact that the specimens used were not in a healthy condition. In regard to the Nearctic Pit Vipers, for instance, Calmette has found that in the venom of *Crotalus confluentus*¹ the solid portion represents about 30 per cent of the total weight, Weir Mitchell and Reichert have found it to represent 25.15 to 27.42 in *Crotalus adamanteus*, *C. atrox* and *Agkistrodon piscivorus*, whilst Flexner and Noguchi, according to the latter, have found it to vary between 50 and 70 per cent of the total weight.

Using the technic described elsewhere in this journal, which consists of inducing the snake to bite through a rubber sheeting placed over the top of a laboratory glass, and emptying its glands by gradual compression, I have secured figures

¹ *C. confluentus* in this case is probably *C. atrox*. Calmette, as most of the European authors, used the nomenclature adopted by G. A. Boulenger in his Cat. Sn. Brit. Mus. 1893-1896, in which the Western diamond-back Rattler (*C. atrox*) is erroneously identified with *C. confluentus*.

that approach those of Calmette, Mitchell and Reichert in regard to the amount of solids in the venom. Flexner and Noguchi must have used snakes with infected mouths (purulent venom) or rather must have made some error in their calculations when they stated that the solid portion of venom (*Crotalus* and *Agkistrodon*) ranged from 50 to 70 per cent of the total weight.

of dried venom being accurate up to 0.0001 gram.

In this table, we considered as exceptional those old specimens that, after having been kept in confinement entirely undisturbed for two to three weeks, yielded an exceptionally large amount of venom.

An examination of the table will show that the

Average amounts of venom secreted at one time by nearctic pit vipers

	Young specimens		Adult specimens		Old specimens		Exceptional specimens	
	Liquid	Dried	Liquid	Dried	Liquid	Dried	Liquid	Dried
	cc.	grams	cc.	grams	cc.	grams	cc.	grams
Copperhead (<i>Agkistrodon mokasen</i>).....	0.14	0.040	0.18	0.050	0.21	0.060	0.26	0.075
Water Moccasin (<i>Agkistrodon piscivorus</i>).....	0.32	0.090	0.42	0.120	0.53	0.150	1.05	0.300
Eastern diamond-back Rattler (<i>Crotalus adamanteus</i>).....	0.84	0.240	1.05	0.300	2.10	0.600	2.65	0.750
Western diamond-back Rattler (<i>Crotalus atrox</i>).....	0.30	0.090	0.40	0.120	0.80	0.240	2.00	0.600
Horned Rattler*-(<i>Crotalus cerastes</i>).....	0.04	0.012	0.06	0.018				
Prairie Rattler† (<i>Crotalus confluentus</i>).....	0.18	0.050	0.32	0.090				
Red Rattler (<i>Crotalus exsul</i>).....	0.36	0.120	0.72	0.240	1.35	0.450	1.65	0.550
Banded Rattler (<i>Crotalus horridus</i>).....	0.21	0.060	0.32	0.090	0.63	0.180		
Green Rattler‡ (<i>Crotalus lepidus</i>).....			0.1	0.03				
Bleached Rattler (<i>Crotalus mitchellii</i>).....	0.18	0.060	0.30	0.100	0.48	0.160	0.80	0.265
Black-tail Rattler§ (<i>Crotalus molossus</i>).....			0.60	0.180				
Pacific Rattler (<i>Crotalus oreganus</i>).....	0.14	0.040	0.23	0.065	0.32	0.090	0.44	0.125
Tiger Rattler¶ (<i>Crotalus tigris</i>).....			0.18	0.060				
Pigmy Rattler** (<i>Sistrurus miliarius</i>).....			0.08	0.02				

* Only 12 specimens.

† Nineteen specimens.

‡ Three specimens.

§ Five specimens.

¶ Two specimens.

** Four specimens.

The table above is based on the extraction of venom from several thousand specimens, the figures in a few instances being checked against those obtained by our collaborators in Texas, Col. M. L. Crimmins and Major R. E. Scott, who have performed nearly 2000 extractions, and Mr. L. M. Klauber of our station in San Diego, who has obtained venom from California species of rattlesnakes a few hundred times, the figures secured by the latter in regard to the weight

ratio between dried and liquid venom is approximately 1:3 in *Crotalus exsul*, *C. mitchellii* and *C. tigris*, 1:3.3 in *Crotalus atrox*, *C. cerastes*, *C. lepidus* and *C. molossus*, 1:3.5 in *Agkistrodon mokasen*, *A. piscivorus*, *C. adamanteus*, *C. confluentus*, *C. horridus* and *C. oreganus*, and 1:4 in *Sistrurus miliarius*. In other words, the solid portion represents about 25 to 35 per cent of the total weight of the venom of the Nearctic species considered in this study.

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27. KILLING BY CONSTRICTION

By FRANK MCLEES¹

In nearly all of the stories describing the killing of smaller animals, and even of human beings, by constrictor snakes the victims are enwrapped in the powerful folds of the serpent and more or less slowly and relentlessly crushed to a pulpy mass by the contraction of the aforesaid folds. As the writer has had but little direct personal experience with pythons, boas and anacondas of the huge dimensions described in some of the accounts he has been obliged to accept the story-tellers' testimony of the methods used by the larger serpents of distant lands. But there have been tales about the comparatively small constrictors of this country and their killings, and the accounts agree as to the complete crushing of the victims' bodies to a state of pulpiness.

Observation by the writer of many such incidents fails to substantiate the claim that the body of a constrictor snake's victim is crushed to any great degree. Then, what is it that causes death? And such quick death! Constrictor snakes have no poisonous bite, and death is quicker than by strangulation or suffocation.

The ground-mole is a tough customer; yet, a strong, energetic mole was dead in a few seconds from the time it was seized and enfolded by a 5-foot pine snake. It was neither strangled nor suffocated, and the pine snake is not poisonous. None of the snake's folds were at any time around its head or neck. When the snake uncoiled and began to swallow it the mole's body was not unduly distorted.

A desire to solve the puzzle induced a close study of the operation whenever there was an opportunity to do so and the evidence seems to point to a very simple solution; the snakes which kill their victims by coiling around them and squeezing them to death by a contraction of the

coils, do so by placing the most powerful coil around the victim's body over the victim's heart. The coils are then quickly tightened until the pressure interferes with and finally stops the heart's pulsations, which means, of course, that the victim is dead. The process may be assisted somewhat by the incidental deflation of the victim's lungs, but death is too speedy to be accounted for by this suffocation alone.

Experiments with a pine snake seem, by their results, to confirm these conclusions. A large specimen is induced to coil about the experimenter's forearm. Then, by spasmodic twitching of the arm muscles in more or less successful imitation of the pulsation of an animal's heart the snake is provoked to squeeze the arm as it would squeeze a small animal it is trying to kill. The writer can testify from several trials that a large pine snake makes, for a few seconds, a most efficient tourniquet; the hand becomes numb and the sensations in the arm are decidedly uncomfortable. The squeezing continues only while the "pulsations" are kept up. As the arm is allowed to relax the snake also soon relaxes. But, in case the pulsations are too long continued the snake seems to tire of the effort; its instinct probably leading it to expect quicker results, and if these do not appear, becoming discouraged and quitting.

In cases where the animal is too small or weak to make a dangerous fight against the attacking serpent the snake does not always take the trouble to kill by constriction, merely throwing a coil or two around it to control it until it can be seized by the snake's teeth, when deglutition begins.

NOTE: The Neotropic ophiophagous species, *Pseudoboa cloelia* ("Mussurana"), after coiling around its victim, twists the latter's body in such a way as to disjoin the vertebral column before it attempts to crush the skull.—A. DO A.

¹ Vice President, Reptile Study Society of America.

X 28. NOTES ON SNAKES AND SNAKE-BITES IN EAST AFRICA

By A. LOVERIDGE

Africa is usually imagined by Europeans and Americans to be teeming with venomous snakes, but if this is true of some portions of the continent, it certainly does not hold good for East Africa and especially the great plains.

Of the hundred and forty odd species recorded from East Africa, only thirty can be considered dangerous to man. Of these, nineteen are referable to the Viperidae, nine to the Elapinae, one to the Hydrophidae (Sea Snakes), and the Boomslang among the Boiginae (Opisthoglypha).

Even this misrepresents the position somewhat as only half a dozen species of these poisonous reptiles are really common or come in contact with man, so it is not very surprising that cases of snake-bite are rare, and fatalities still more so.

I. THE ELAPINE SNAKES

The Cobras

Of the elapine snakes, priority must be accorded to the cobras, of which there are three species in East Africa. Because these snakes do not go about with hoods erect and swaying in the manner in which they are usually shown in pictures, it is often difficult to convince people that they may yet be cobras. Unless disturbed, a cobra has the appearance of many of the harmless snakes, it is only when annoyed, or cornered, or scared, that it erects its hood. The Black-lipped Cobra (*Naja melanoleuca*) inhabits Uganda and the western portions of East Africa; the Egyptian Cobra (*Naja haje*), though ranging from North Africa to Zululand, is rare in south-east Africa. The only specimens which I have seen were caught in Shinyanga district, or killed at Mt. Longido and Kilosa. The latter, a male just under six feet in length, was shot as it lay beneath a rock in a dry ravine called Mbweni; its stomach was found to contain a mass of mammal fur and a piece of tree bark measuring 31 by 26 mm., obviously swallowed inadvertently with its food. Half-a-dozen cobras from Shinyanga were sent to me alive, but refused food during the month they were in my charge. I doubt if one of them was less than 6 feet in length. The Wanyimwezi call this snake "*kiparungu*," and the Wakami, "*sakamala*."

Though it is a matter of surprise to many persons to learn that there are cobras in Africa, yet the Black-necked Cobra (*Naja nigricollis*) is a common snake at such centers as Mombasa, Nairobi, Morogoro and Tabora, besides being widely distributed throughout the country. This is the snake most frequently and erroneously called the Black Mamba. Whereas mambas have only a very limited power of flattening their necks, cobras, when startled or enraged, will spread a hood two or three times the normal diameter of the "neck" by erecting their long "cervical" ribs in the same way as a man might raise his arms.

The Spitting Cobra is variable in coloration. At Nairobi an olive-colored form is found which has lemon-yellow markings on the throat; however the commoner slatey-black variety also occurs there. Young ones are greyish or slatey-grey with pink bars on their throats. At Longido the usual type is uniformly salmon-pink above, and either without markings of any kind, or as in one specimen which I caught, there may be a black band on the throat seven scales wide. Two specimens killed at Mombasa were a slatey or slightly greenish-grey above, their bellies dirty white with indistinct, or isolated, smudges on the ventral scales and a highly iridescent brown band fourteen scales wide on the throat. A Mwanza snake, while entirely black above, was mottled white and black below but without any gular bandings; yet another taken in Mkalama district was entirely black both above and below.

I came upon a young Tabora cobra while clambering over a kopje; with hood erect the snake came straight for me for the best part of a yard, "spat" some venom, then turned into a crevice. This was evidently its home and hence the reason for its approaching me. It struck me at the time that the prominently displayed red and black banding of the throat was obviously of the nature of "warning coloration."

I gather from a description given me by Mr. Hignell that this snake does occasionally occur at Dodoma, though none were seen during the four months I spent there in 1926. At Saranda, however, I got two on successive days and one of

these was the biggest cobra I had yet taken; it taped over six feet alive and I feel confident would be about seven feet dead and properly straightened out.

This fine reptile was encountered in open maiombo forest and wriggled across our route. I gave chase and threw my stick at it as it speeded up, this caused it to raise its hood but it came on (I had headed it off meantime), and being stickless I stepped aside; it passed me with a rush and went down a hole only a yard from where I had been standing. Though flush with the ground this hole appeared to be part of some old termite galleries.

By means of a hoe, I had the surrounding vegetation cleared in a 10-foot circle. This revealed another hole which I plugged, then putting a long stick down the central shaft I stirred it round; in a matter of seconds up shot the cobra's head and it spat as I retreated. This occurred three times, but the snake refused to come out. Digging in the hard ground with the hoe disclosed the fact that it had retired into a side gallery, out of which I poked it, but this only resulted in its taking refuge in another, where I was successful in pinning down its neck with a forked stick and taking it out. It spat between a dozen and twenty times, and its venom was in no way exhausted right to the end, for when putting it into the bag, it nearly hit Salimu who was holding the bag for me.

At 9:30 a.m., the previous day, I had seen the head of a black snake protruding from a knot hole in a maiombo tree, the hole was $5\frac{1}{2}$ feet from the ground. Thinking it was either a Boomslang or Black Tree Snake, and without giving cobras a thought, I walked up to within 4 feet of it, twiddling the fingers of my left hand while I imperceptibly approached my snake stick with the right to within 2 inches of his neck.

During this time my eyes were fixed on the oblique scales of a few inches of his neck, which confirmed my idea of a Boomslang, also the head seemed much narrower than that of a cobra. I pinned it by the back of the neck against the side of the knot hole, but this being very smooth, the snake, having plenty of purchase power, jerked his head free and disappeared into the hole, giving me, as he did so, a glimpse of white scaling on the throat. For the first time I realized the snake was a spitting cobra, to whom I had been presenting my eyes as a target at a range of 4 feet!

I poked a wand 10 feet up inside the tree without effect, then got Salimu to cut away the earth, termites and decayed wood which filled a hole at the base of the tree. Presently he thrust his bush knife into space and triumphantly announced the way clear. Poking with the wand had no effect, so we lit a smoky grass fire at the base of the tree, but very little smoke drew into the trunk owing to the fact that the wind was against us. Salimu raked out the smouldering grass and again thrust his *panga* into the hole, then jumped back exclaiming "*tayari*" (ready) as the cobra's tail flopped into view. I grabbed this and pulled the owner down and out as he made haste to ascend the hollow trunk, but dropped him like a hot cake when his head came into view. He made for the next tree, but pursuing, I flicked him into a more open space, and had time to see that he was about 4 feet long. At this juncture he nearly got away, for he travelled very fast down hill towards a belt of impenetrable scrub. In trying to overtake and pass him with my eyes fixed on him, I ran blindly into a big bush of wait-a-bit thorn, which hooked into my bare arms as well as my clothes and so took me some seconds to free myself. I shouted to the boys to head him off, but Salimu, who, like myself was very much out of practise, shielded his eyes with a slouch hat and would not go within 30 feet of its head; the other boys also were very tardy about coming forward. Salimu in passing him, however, caused him to halt in a bush and raise his head with spread hood. Just as he dropped to the ground I ran in and flicked him back 10 feet. He spat several times but my eyes were shielded by my helmet. The cobra now tried to push his head under a fallen tree trunk and gave me the opportunity of running in and pinning his neck to the ground; the rest was plain sailing, though I had only a rather small bank cash bag to cram it into.

After my cautious handling of these snakes it was one of the most interesting and amusing incidents of the whole trip to watch Gurukesi and Kifinda (two Wayeye snake-catchers) remove these, and four others from Shinyanga, from their cage to pack them for shipment.

They were certainly very respectful towards the big one, but the others which were about 4 feet long, Kifinda pulled out of the cage by their tails. Holding a cobra at arm's length in his left hand, with inflated cheeks he would make a dab with his right hand for the back of its neck;

sometimes he missed and the twirling, wriggling reptile would nearly get him as it struck at his hand. Nevertheless neither of them were bitten on this occasion. They both stated, however, that they had been bitten many times by Black-necked Cobras, which are common in their district and whose skins are in considerable demand for binding round the drums used in festivities.

When bitten they apply the "musaweye" medicine (as detailed under the notes on puff adders) but do not drink a decoction of it. They recover within twenty-four hours! I asked if they had ever known anyone die from a bite of this snake; they replied in the affirmative, but said that if you applied the medicine and died it was not a real snake but a wizard (mchawi), in which case, of course, you could not expect the medicine to be efficacious!

They believe that it spits in your eyes to blind you, then bites your feet! If the venom gets in their eyes, they apply a dawa, "katamakamakikulu," made of leaves of a small plant bearing the same name and only a few inches in height. These leaves they chew, then rolling some other leaf to form a funnel, they discharge the spittle into the eyes of the person attacked, who is cured within the hour! I questioned this and they said it was no infrequent occurrence for their dogs to put up a cobra and get spat at in the eyes; they claimed to be able to cure the animal immediately with "katamakamakikulu," so that it could resume its walk without the eyes being inflamed or sight impaired.

To prevent a snake spitting they put a dawa, called "ilende," into its mouth so that the poison will not fly out but only dribbles from its jaws! Alternatively another plant, called "ilumbalumba" is taken in the mouth of the snake fundi while he is bagging the snake and it causes the snake to miss its aim! This plant has a very pungent smell; they brought me one at my request, for it grows at Dodoma. I asked why they inflated their cheeks when handling the cobras, they replied that the snake was less likely to spit at you when this was done as the reptile thought that you were going to spit at it. Nevertheless these snakes did spit, though none of the venom got in their eyes for they were quick in turning their faces away.

By reason of this power of projecting its venom a considerable distance this snake has well earned the title of "Spitting Cobra," though it should not be confused with the South African

Ringhals (*Sepedon haemachates*) which has the same habit. The Egyptian Cobra has been reported to do so occasionally. Quite recently one could find plenty of persons in England who absolutely denied that these snakes had the ability of projecting their venom in a jet; others "imagined" that the venom may spurt or dribble from the creature's fangs in its excitement, and that this might "accidentally" get into people's eyes. Others again held that it was saliva and not venom that was ejected.

Anyone who has captured this cobra knows perfectly well that some fluid is ejected for a distance of 6 feet; that it is invariably directed at the face, if not the eyes, of the would-be captor, with the result that it generally gets in the eyes. If you place a freshly caught specimen in a case and press your nose against the glass, the snake will eject fluid in two streams which flow down the glass quite separately. The ejection is nearly always accompanied by a faint hiss, the discharge of air from the trachea has probably the effect of spraying the venom. Venom alighting on the author's neck, arm, or clothing was always sprayed and dried in fine spicules almost immediately.

For true "spitting," soft lips are required; these a snake does not possess, so strictly speaking we should not say that it "spits;" however, as the word conveys the idea rapidly it is no worse to continue to use it in this connection, than many other misapplied words in our vocabulary. The venom of the parotoid glands is conveyed by a duct to the anterior base of the poison-fang where it opens on to the groove which traverses the anterior surface of the tooth. The edges of this groove in a cobra's tooth almost meet, so that it nearly forms a canal with an opening at the base for the in-flow of venom and an opening at the point for the out-flow. My view is that possibly the opening of the poison duct is slightly raised from the opening of the canal, that the venom is expressed by the powerful masseter muscles which enfold the gland, and that it escapes from the opening of the duct and is given direction by the grooved surface of the poison-fang which is tilted up towards the face of the reptile's opponent.

Owing to this habit of discharging their venom the capture of a cobra is almost invariably an exciting matter. Unless the venom happens to fall upon a cut or abrasion of the skin, there is no danger apart from its entering the eyes. The

immediate result, should this happen, is intense pain and temporary blindness caused by the superficial blood vessels absorbing the venom. This conjunctivitis subsides in a few days if prompt treatment is applied.

A settler, who kindly promised to collect snakes for me if provided with a preservative, was given a bottle of 5 per cent formalin solution. A few days later he disturbed a cobra in his rickyard. It vanished behind a disused door which, removed from its hinges, was standing on its side against a shed. Just as the snake gained this shelter my friend struck at it with a panga, severing a portion of its tail. He then ran round to the other end of the door and peering in saw what he was looking for—an angry cobra with spread hood facing him at close quarters. His brother led him back to the house,—what should they do? Perhaps as formalin was a preservative for snakes it might have an antidotal effect on the venom! Good idea, so he bathed his brother's eyes in the solution. A week later I met my friend jogging down Government Road on a mule, his eyes were inflamed and "No more snake collecting for me," were his first words of greeting. Subsequently he admitted that he scarcely knows which is worse, venom or formalin, when applied to the human eye.

I know of a family residing near Nairobi in which nearly every member, and many employees about their farm, have been spat at in the eyes at one time or another. I wish to emphasize this point that the cobra deliberately aims at the face, as only recently I read in a journal that it was a matter of accident when the venom reached the eyes. The lady of the household referred to, on going to the fowl-house, where it was none too light, saw something dark in one of the boxes, and supposing it to be a fowl she bent over it and received a charge of venom full in the face, the resultant shock and pain was so great that she could only sink on her knees and call for help. Her husband arrived and with a shot-gun blew the snake to pieces.

One evening I was having dinner in my grass hut. Outside, though only six feet from me, Salimu was squatting in the beam of light from a powerful acetylene lamp. He was engaged in extracting a nail from a box.

"*Hapana mzuri.*" said he, standing up.

"What's no good?" I asked, as he stepped inside.

"Cobra," he replied in the vernacular.

"Where's a cobra?" I inquired abstractedly.

"Look," and he exhibited some glistening drops of venom on his arm, "It is not raining, *Bwana*, and I heard it hiss."

Apparently a cobra had come out of the loose stones of which the terrace was constructed and "spat" at him, startled into doing so no doubt by some sudden movement on his part.

A friend of mine was crawling through some grass to obtain a final shot at a hartebeest which he had wounded. Suddenly up rose a cobra before him, he had presence of mind to tightly close his eyes and received the venom upon his eyelids. Lying back, he awaited the arrival of his syce, whom he instructed to take his water bottle and pour its contents on his face. Then, after a careful sponging with a wet handkerchief, he opened his eyes and was none the worse for the unpleasant experience.

A keeper in the gardens of the Zoological Society of London received a box of snakes from West Africa. Seeing there was netting beneath the lid, he started to pry up the slats, when he received a charge of venom in his eyes at very close range. A year later he was still suffering from the effects, his eyes looking weak and watering at the slightest strain. He informed me that he could never read by artificial light in consequence.

A large cobra got into a chicken roost at 5 p.m. and struck a hen in its nest box. The Sergeant in charge of the fowl sent me an urgent note to come at once as there were three Black Mambas in the fowl house! I was out, but Salimu went and saw one cobra but felt indisposed to interfere. The Kikami name for this snake is "*kigau*," but the Waswahili call it "*fera*," the Black Mamba on the other hand is known as "*mfune*."

When camped on the slopes of Mt. Longido in 1916 a corporal of our regiment asked me if I could tell him the name of "a terra-cotta" snake. "It is harmless I think," he added, "because, when I found it beneath my pillow, I jabbed a jack-knife into it and it glided into the wall without attempting to bite." Together with another corporal he had made a bivouac by fixing two ground-sheets against the loose built wall. Nearest the wall this improvised tent was not more than 4 feet from the ground, and to enter it was necessary to go on hands and knees. As I rode into camp one morning I was hailed by the other corporal, who lay reading in the bivouac. He called out casually, "The snake is

here now, lying on the blankets, if you want it," and he rolled back to continue reading.

Picking up a short stick I asked him to vacate, that I might get in. On hands and knees he waited on the one "bed" whilst the "pillow," alias a kit-bag, was overturned, revealing nothing. Blankets, etc., were also removed without avail. Putting my cheek to the ground I looked into the wall and was able to see the coils of a pink cobra in the interstices. Cautioning the by-standers as to the snake's propensities for spitting, I pinned the nearest coil down with one end of the stick and placed my foot upon the other while I rose to a stooping posture, as it was impossible to stand erect.

Almost simultaneously both ends of the snake appeared. The reptile struck at and chewed the toe of my boot, the tail squirmed and writhed like a worm. Seeing the head was occupied, I seized the tail, relaxed the pressure of the stick, jerked the creature from my boot, and tossed it out into the open, where I was able to pin it down before it had time to recover its composure. Some of the bystanders were pleased to express scepticism as to the reptile being a cobra so I wound a thread around its jaws and released it on the horse-lines, where it sailed about, hood erect and swaying to and fro to the entire satisfaction of the critics.

Another time I was sitting in my tent at Morogoro, talking to a friend, when a native rushed up from a nearby camp and, merely gasping "*Nyoka Bwana*," was away before we could interrogate him. Seizing a lamp I followed him through the camp till, halting near his grass hut, he awaited the arrival of the light. By its rays we could see a fine black cobra streaking away at full speed in the direction of a marquee around which some forty natives were sitting on empty boxes and upturned petrol tins. They also caught sight of the snake and a fine commotion ensued, with tripping over tent ropes in the darkness and an accompaniment of overthrown petrol drums.

Shielding my eyes with my helmet I headed the snake off and as it turned, got in front of it a second time when it stopped. The night was one of inky blackness so that when the snake was on the move it continually got beyond the rays of the solitary lamp. When a second light was brought I quietly approached the snake and pinned it down by means of a forked stick applied to its neck, the ground being hard, however,

and the fork too large, the reptile withdrew its head and "spat," though in the darkness I could not see where the venom went. A second attempt was more successful and I was able to pick it up by the neck and transfer it to a cage unhurt.

Another, but only a couple of feet long, was secured within 10 feet of my tent as it was wriggling towards it in a ditch. Here again the ground was too hard and the snake, turning over under the fork, spat at its would-be captor just stooping to seize it. By following the injunction and turning my cheek to the enemy at the critical moment I received the charge of venom on my neck and arm from wrist to shoulder.

Scarcely a week passed without my being called upon to catch a cobra at this camp. One day I was summoned to secure one that had been seen basking on a heap of stones close to the door of the soda factory of the fifteenth Stationary Hospital. There were fully a ton of boulders in the pile which was close to a dense thicket of bamboos, which complicated matters. With the assistance of a native I removed the boulders and tumbled them one by one down a steep slope just behind. At last, when almost the whole pile had been shifted, we caught sight of its coils and a few seconds later it made a dash for the bamboos as I was removing a big boulder. Dropping the crowbar I seized my snake stick, which a native had been holding in readiness, and intercepting the snake, tumbled it down the slope. As I followed it was trying to ascend but continually slipped upon the gravelly and shifting surface. I jumped over it, and taking it in the rear, pinned it down with comparative ease and not in the least injured. It was kept in captivity with the others and when eventually chloroformed was found to measure $4\frac{1}{2}$ feet.

Another day an orderly brought me a dead fowl from the Sick Officer's Mess to know whether it had been bitten by a snake, but I could find no fang marks or other sign of poisoning. About 9 a.m. another orderly came to say that one of the Nurses had seen a cast skin in a hole near the chicken run. They had choked the hole with stones, would I come and get the snake out? They seemed very worried about it, so I went. After removing some of the stones I came upon a fragment of slough and I was able to prophesy from the scale rows that it was a poisonous species. I suggested that some boys had better be set to work with picks and I would return

later. When I went back I found an interested crowd—six officers, three nurses, four or five orderlies, and about a dozen natives—some of them had caught sight of the reptile, which had promptly “spat.” The venom had carried 4 feet they said. I set to work and presently hooked it out of its retreat and captured it as it attempted to escape.

A friend of mine had an interesting experience at Tabora shortly after the occupation of that town. He was billeted in one room of a small house; the room was bare except for his camp bed, washstand, chop-box and a few similar items. For the sake of coolness the door was ajar; beneath his mosquito canopy he read some home newspapers, just arrived, till feeling drowsy he cast them beneath the bed and fell asleep. He was awakened during the night by the rustling of the papers which sounded as if something was dragging them round and round. “Rats,” he thought and tried to spur himself to wake sufficiently to cast a boot under the bed to scare them, but sleep again overcame him. A frightful yell and the door banged! It was morning, and now thoroughly awake he called out to know what was the matter. His servant from the security of the passage called back that there was a snake in the chop-box, he, the native, had softly entered the room to get some tea leaves before announcing “*Chai tayari.*” On lifting the lid of the chop-box (which was not properly closed as the hasp had caught against the staple), judge of his surprise on seeing a big black snake lying coiled within, hence his sudden retreat. My friend spoilt it as a specimen with a service rifle.

Shortly after my arrival in East Africa, I went out collecting on the plain just below Nairobi Hill. Along the stream we had seen several Green Snakes, so that when my gun boy suddenly called out “*Nyoka, Bwana,*” I supposed that it was one of these he had seen. Laying my gun in the grass, and taking my forked stick from him, I followed his directions, but at first could see nothing. Suddenly I saw a brown streak going full speed in the direction of a termite hill some 20 feet from where I was standing. I recognized it at once as a large Spitting Cobra about 5 feet in length. Giving chase I struck at its tail in the hope of checking its career so that I might have an opportunity of catching it. The snake half turned, and so did I, not being very used to

their ways at that time. With scarcely a pause, however, it kept on, so I followed and this time struck it on the back, then swung around immediately to receive a shower of venom on the back of my jacket. Turning again, I caught a glimpse of the cobra swaying slightly with spread hood and more than a foot of its body upraised; it was a fine sight, and one that I would not wish to have missed. The moment it “spat,” I again gave chase, but by this time it had almost reached the hillock and next moment vanished down a hole before I could overtake it. At noon next day I returned to the heap, provided with a pair of goggles. It would be as well to explain that this termite hill had a diameter of about 20 feet, a height of 10 feet, and was overgrown with rank grass and weeds a couple of feet tall. I circled the heap, then walked all over it, but never a sign of the snake, which I concluded was probably taking a day in bed after the excitement of yesterday. I had given up all hope of seeing it and was standing on the side of the hillock, the grass above my knees, when I fancied I heard a rustle, however all the grass was a-rustle with the breeze, yet just in case . . . I casually struck the ground in front of me with my stick then listened . . . silence! I next tried the side of the hillock directly in front of me, perhaps a yard away, scarcely expecting any result. The effect was as sudden as the pressing of an electric light button, swiftly and suddenly up shot the blessed reptile, swaying slightly, hood spread. Being well up the side of the hillock it was not a yard distant and nearly on a level with my face. My goggles, which were down on my chin, were over my eyes in a moment; simultaneously I whacked the snake on the side with my stick. It appeared to fall over the stick and I tried to heave it off the hillock and at the same time pull the stick towards me; this only resulted in the forked end being pulled out of the ferrule. The snake dropped into the long grass and down the hole, which was nearly vertical. Though I paid several visits to the place, and a few days later found a piece of sloughed “skin,” I never saw that cobra again, nor did I use goggles again.

At Nairobi also there was great excitement among the house boys one morning. One of them had surprised a Black-necked Cobra sitting up in the garden with its hood spread, facing the cat. The cat was crawling round the snake with her belly low on the ground; the cobra kept

turning to face the cat. The remarkable thing was that the former had not already "spat" in her face as they do so at dogs who disturb them. All the older "boys" and their friends to the number of eight, gathered round at a respectful distance and left it to the youngest—the cook's *mtoto* to do something. The urchin, seeing, as he said, that the snake's attention was fully occupied with the cat, stole softly up and gave it a most unexpected blow across the hood with a short stick that he was carrying. This stick was less than 3 feet in length. He then bolted into the house to give the news; when we arrived the cobra was squirming but helpless, and died during the course of the day. It was a female, measuring 4 feet, 8 inches; was in the pink of condition with layers of fat about all its organs. Its stomach, however, was quite empty and doubtless this fact, in conjunction with the heavy rains of the preceding evening, had started it wandering abroad in daylight. Quite possibly it was making for the fowl-house when it met the cat, and incidentally, its end.

Mammals, birds, reptiles and amphibians are alike included in the menu of this species, no doubt this fact explains in part its wide distribution and comparative abundance. Its dietary leads it to frequent the haunts of man, where it is often found in sheds, fowl-houses, rubbish heaps and even tents. In open country they prefer to take up their abode in termite heaps upon which they like to lie and bask in the morning sunshine.

On arriving at Frere Town I was informed by my host that he had been greatly plagued by a cobra in his fowl house. During the three previous nights it had killed six pigeons, two pigcons, and one pigeon respectively. At 7 o'clock that evening I received a message that the cobra was coiled in the rafters of the fowl house at a height of 12 feet from the ground. On arrival I saw that capture was impossible and sent back for a 0.410 collecting gun from which I delivered a charge of No. 10 shot. The concussion in that small iron building dislodged the dust of years, so we promptly retired outside. On our return a few seconds later there was a flop and down fell the cobra at our feet, still writhing and striking this way and that. It measured 64 inches and in its stomach was a young pigeon, while two pigeon's eggs were in its gullet.

Twelve days later, just after dark, there was another great outcry among the poultry, and

my host running out with a stick surprised a 66½-inch cobra swallowing a chicken, taken thus at a disadvantage it was easily dispatched. Everyone agreed that it was the mate of the first come in search of its fellow, but unfortunately for this popular belief, both were females.

At Morogoro a native brought me a chicken coup containing a dead cobra, a dead fowl, and three dead chickens, one of which was headless. A few days earlier this snake was supposed to have taken three other chickens from the same coop. This time the natives, hearing cackling, ran out and killed the cobra, but not before it had bitten the fowl and her brood. Opening the snake I found another chicken in its stomach and a chicken's head in its gullet, so surmise that it was in the act of swallowing the latter when struck by the boys, who probably struck off the chicken's body in their attempts to hit the snake upon the head. The length of the cobra was 51 inches. They had brought the little collection to me because their master was away for a few days and they wanted a witness to the catastrophe which they would have to report.

At Lumbo some natives killed a fine cobra in the act of swallowing a large hissing sand snake (*Psammophis sibilans*). The cobra measured 50½ inches and had already swallowed 28 inches of the sand snake whose body measured 33½ inches; unfortunately, in the excitement of killing the cobra the greater part of the tail of the sand snake had been cut off, but other specimens of this body length had tails of between 12 and 13 inches, so that a 50½ inch snake was engaged in swallowing a 46 inch snake and would doubtless have succeeded but for the interruption! I have known one to eat four toads (*Bufo regularis*) in a fortnight, another three in one day, and a still more remarkable case of gluttony occurred at Morogoro. I went out with a lamp and put two toads in a snake's cage occupied by a single half-grown cobra. It seized the first toad and when I returned was chasing the other round the cage with the first in its mouth. It struck at it again and again, but of course without effect. It then paused and swallowed energetically. When the first was disposed of the second was bitten in the abdomen, held for half a minute, then released, but as it began to hop it was seized by the hind leg, and for nearly twenty minutes the cobra attempted to swallow it hind-part foremost. At the end of that time it took the head in its mouth and swallowed it with ease.

Precisely the same thing occurred with the third toad, which speaks badly for the reputed intelligence of the cobra. A fourth and fifth toad followed, but I did not stay to witness their engorgement. During the process of swallowing a very large toad, its deglutition was one of the most difficult and labored that I have ever seen; the head lost all shape, resembling a circular band of skin in which shone two beady eyes, the quadrate bones stuck up against the distended skin like horns about to bud, the toad no sooner passed into the throat, however, than the head regained its normal appearance with much yawning on the part of the cobra. Six days after this meal of five adult toads, the half-grown snake resumed its usual proportions.

This Black-necked Cobra so rarely bites, preferring to "spit" when disturbed, that the following case is of no small interest. A very intelligent native in my employ was returning home one evening at dusk (6:30 p.m.) when he stubbed his foot against what he thought was a stick lying across the road a hundred yards from Kilosa station. Next moment with a short hiss the cobra launched at him and struck with both fangs just above the left ankle—Ramazan's feet being bare of course. The snake withdrew immediately and set off in the direction of the railway line; Ramazan ran after it, and the snake rose and spread its hood; the native looked about for a stone, but his friends called to him to withdraw or he would get bitten again. He rejoined his companions and very soon began to feel sick, so went to a native *Wanyimwezi* "doctor," who first applied a ligature above the knee and then made from nine to a dozen horizontal incisions above the site of each fang-mark, i.e., between the bite and the heart, and into these rubbed some "medicine."

Ramazan was taken home by his friends, and on arrival ate some corn-meal, their usual evening food, but brought it all up. On the following day, every time he attempted to eat, he was unable to retain anything and he said he felt successive waves of venom come up from the leg as far as his throat and then recede again. Two days later he was well enough to return to work. In considering the effectiveness of the treatment, it should be borne in mind that in the case of the Indian Spectacled Cobra, something like forty per cent of the natives bitten recover without any specific treatment.

I met a weird old "snake charmer" in Mwanza

district who had in his possession a 68-inch cobra which he kept in a small bark basket. The first time I saw him playing with it, the snake slid out as he was putting it back in the box; this happened two or three times till the old man lost patience and slapped it on the head, when, quick as thought, it apparently attempted to spit in his face, and as he was stooping over the box-basket his face was not 2 feet from the reptile. I was within 4 feet myself, and remarked that no venom accompanied the open-jawed hiss,—he replied with a laugh that the venom was finished. For a small consideration he elected to become a camp follower and perform daily for the benefit of the natives as a preliminary to my offering rewards for snakes, lizards, etc., brought in. A few days later, when holding his daily display, tying the cobra round his naked waist or wrapping it two or three times round his neck and flinging its head over his shoulder, so that it struck his back with a resounding whack, my curiosity was so piqued that I bought it from him and chloroformed it. The poison teeth and glands were intact! There was a little charcoal in its stomach similar to a handful which he kept in the bottom of its basket and which he said constituted its food. That, of course, was nonsense.

This reminds me of a *Monyimwezi* snake-catcher who was in my service for a year, the only genuine snake-catcher I ever had. Some distance outside Morogoro was a house in which I heard was a collection of snakes, and on further enquiry I learned that the native who had secured them for the German proprietor lived somewhere in the district; after sundry fruitless attempts to locate him I told the local chief—Kingo Morogoro as he is called—of my difficulty and he promised to see what he could do.

When walking along the river a week or so later I heard a cry of "*Bwana Nyoka*" behind me and turning, saw an elderly native being dragged along by half-a-dozen excited youngsters who were clinging to him. On coming up to me he explained in the most diffident manner that he had heard that I wanted him; that Kingo Morogoro had told him to come to me as he was the man who had collected the snakes for the German who formerly lived there. He showed me that a fore-finger was missing, it had been struck by a Puff Adder and the German had insisted on cutting off the finger, though Macharia claimed he would have been all right without the ampu-

tation. He was quite consoled by the forty rupees which he received for the finger!

He explained that he was employed by the railway, then under military administration, so I accompanied him to the station master and made arrangements for his discharge so that I might engage him. Macharia was one of the most picturesque natives I have ever seen. He wore a slouch hat adorned with an ostrich feather, which he removed with the most graceful sweep when addressing a *mzungu* (European). He had a kindly old face and was very popular with the children. He explained that snakes were not to be caught every day but that if he might live at home and work on his land he would come in once a week and bring his catch, and I could pay him on a commission basis. He left shortly after noon and returned at 5 p.m. with a snake done up in a scrap of cloth. It proved to be a cobra. I put the cobra in a cage, but unlike the others, it never fed and seemed less spirited for a freshly caught snake, so after a couple of weeks I chloroformed it. Then I discovered that its lips were sewn together *inside* in three places, looking at it with closed mouth there was nothing to indicate this state of affairs. Macharia probably thought that I was too young and inexperienced to be trusted with a snake and had never seen my cages of live snakes until he brought the cobra. I scolded him well for his cruelty and the offence was never repeated.

The Mamba

There are three species of mamba recorded from Tanganyika Territory, but it is the Common, or South African, Mamba (*Dendraspis angusticeps*) that is the subject of these notes. It has two color phases, the green and the black, though as far as my experience goes the so-called 'Black Mambas' are not really black as are the Black-necked Cobras, but dark olive, which, when the snake is alive and on the move, appears black. Green Mambas are invariably found in trees, I have never seen one over 6 feet, though they have been recorded as reaching a length of 8 feet. Black Mambas, on the other hand, are rarely found under 8 feet and attain a length of 14 feet.

The mamba, which may quite correctly be called a tree cobra without a hood, derives its name from the Zulu one for this snake, for they call it *inmamba*. Unfortunately *mamba* is also the Kiswahili name for crocodile, by which that reptile is known throughout East Africa.

As explaining the dread which the natives have for this snake, I mention a case which occurred in Kenya. Two Europeans entered a grass hut on an estate. As the second turned to leave and follow his companion out, a mamba, which had been in the hut though unobserved, struck him in the back just above the kidneys. Although preventative measures were undertaken immediately, he died twenty-four hours later. My informant was his companion. A native, whilst bringing a tea-tray on to the verandah where his master and a friend were sitting, trod on a mamba which was lying on the mat. Dropping the tray he attempted to reach his master, but fell and expired within the minute. My informant, who was the visitor, vouched for the literal accuracy of his statement.

Such cases are almost unheard of in East Africa, though not infrequent in Natal and the Transvaal. The following incidents, most of which occurred last year, are taken from my press cuttings album.

"An extraordinary snake episode was experienced at a farm in the Barberton district recently, when, during ploughing operations, a black mamba suddenly rose in front of the plough, and, getting on the backs of the hindmost two of the span, worked its way forward, biting every alternate ox, till it had struck four," states the *Farmers' Weekly* of South Africa.

"The snake first bit the right-hand ox of the hindmost pair, and the left-hand animal of the second hindmost, and then the right-hand one of the third hindmost and so on. After biting the fourth it attempted to get away but the Native in charge managed to kill it. The mamba was found to measure about 9 feet.

"Two of the first oxen to be bitten died during the day, being badly swollen. The other two also became swollen, but recovered, and on the following Saturday were regarded as being out of danger."

"In the Gatooma district recently, Mr. Knight, of the Eiffel Blue Mine, Mr. Ward of the Glencairn Company, Mr. Johnston, a contractor, and others, accompanied by eight dogs and a few natives, went pig hunting. Suddenly the dogs pointed something, and in rushed a little pet terrier and seized a huge black mamba. Before the party could fully grasp the situation a pointer was bitten and had dropped dead. Another pointer suffered similarly the next moment, the terrier being the next victim. By this time the excitement was intense. All the sportsmen and the remaining five dogs had joined in the melee. A greyhound was next bitten and died, and then its owner fired and blew part of the mamba away. Immediately another member of the party got in a few successful revolver shots, but not before all the dogs had been bitten and seven had died including a great Dane valued at £80. The eighth dog, which was missed, later turned up at the St. Aldwyn Mine, and was given to a kaffir to take to its owner's residence, but it developed a strange attitude and endeavored to bite the boy, who was

frightened at its demeanour and let it go. It has not yet been found."

"A man named Botha, farming near Mara, in the Pietermaritzburg district, died two hours after being struck on the leg in the death struggle of a large mamba that had been cut in two in the course of his ploughing operations. He was turning up new land after the recent rains."

It was a red-letter day when I captured my first mamba in a mango tree close to Morogoro station. The morning before I had been standing beneath a mango tree watching a carpenter-bee when my attention was attracted by a movement in the foliage of a branch a yard above my head and not more than 8 feet from the ground. A snake was slipping quietly away when my gun-bearer, observing it, gave a yell and jumped away causing it to quicken its pace and climb straight up through the dense foliage. Throwing up a butterfly net, which happened to be in my hand, I tumbled the snake down 4 feet, but before I could recover the net for a second throw the snake had made up the lost ground and was out of reach. I was under the impression that my quarry was a Boomslang (*Dispholidus typus*). The only "spot" difference between these two tree hunting reptiles is the larger eye and more oblique scales of the Boomslang; as only the body of the mamba could be seen it was difficult to be certain of its identity.

Returning to the mango tree the following day, and cautiously approaching the bough on which it had been lying, the snake was easily seen by reason of its having selected some darker foliage against which its bright green coils were conspicuous. At the first attempt the mamba was dislodged to a lower branch and at the second was hooked out of the tree on to the ground. It immediately started off but was overtaken and captured.

The same day—January 30—I found no fewer than four young mambas on a bush half a mile distant from the mango tree. They were evidently only just hatched, for the ventral scutes in the umbilical region had not as yet healed up, yet they were fierce enough and attempted to use their fangs. Three of them were captured and I was strongly impressed with their superficial similarity to the harmless Green Snakes (*Chlorophis* spp.), or Spotted Wood Snake (*Philothamnus semivariegatus*). On March 5 I captured another young one, 2 feet in length, near my tent, the scutes were unhealed but there were traces of food in the stomach.

On March 31, almost on the same spot, a second newly-hatched mamba was taken measuring $17\frac{1}{2}$ inches.

About this time, when in waist-high grass, I found the nest of a Black-bellied Bishop Bird (*Pyromelana nigriventris*), with a dead hen bird sitting upon three eggs containing live young! A few ants were crawling about the eyes and mouth of the dead bird, but it was so fresh that I was able to leave it twenty-four hours before skinning. Seventeen days later I examined the same nest and found two more eggs in it so it appeared as if the cock bird had installed another mate in the nest. The death of the bird may possibly be explained by the presence of a Green Mamba (*Dendraspis angusticeps*) which was lying sunning itself on a thornbush not 20 feet away. It is reasonable to suppose that it had bitten the bird, which had probably been just able to flutter back to its home before succumbing to the effects of the poison.

The two largest specimens which I kept in captivity measured 8 feet $1\frac{1}{2}$ inches and 7 feet, $3\frac{1}{4}$; both were females and when first confined displayed great activity and struck at the glass whenever anyone approached; possibly realizing the futility of this procedure which gave them sore snouts, they abandoned it, but for a couple of months continued to draw themselves up and menace the visitor with widely open jaws. In time even this menace was given up, but till the last they continued to follow every movement of the onlooker with bright eyes and quick turns of the head. Unfortunately they had to be confined in a very small cage which was a tin-lined Huntley and Palmer's biscuit box measuring approximately $1\frac{1}{2}$ by $1\frac{1}{4}$ by 2 feet.

Their deaths were purely accidental. It was my custom to take them out of the case once a fortnight while I cleaned it. Their removal was accomplished by opening the sliding glass front an inch and pinning down the head of the nearest snake with a straight stick. As it was strong enough to throw this off, the snake had to be seized immediately and withdrawn, any attempt of its companion to follow through the open door was frustrated by simply menacing it through the glass with upraised hand, this was sufficient to cause it to draw back its head on the defensive in readiness to strike. Once, when I had taken the larger one out and was holding it firmly by the neck between finger and thumb of my left hand, it threw such strong coils round my arm

that I felt a numbness creeping into my fingers so that it was all I could do to retain my grip while Salimu unwound the coils. On the last occasion I had transferred them to another tin-lined box, which was exposed to the afternoon sun, while their own cage was being cleaned. While I was thus engaged a friend unexpectedly called and we withdrew for tea; on my returning an hour later I found the hapless reptiles dead. They had undoubtedly succumbed to the heat of the sun, and if there had been water in the box to create a moist atmosphere this would not have happened.

Only that morning one of them had eaten two large Black Rats (*Rattus rattus alexandrinus*), and now measured $6\frac{1}{4}$ inches around the stomach. Opening this snake I found that the flesh and fur had already been digested from the rat swallowed eight hours previously. They both fed readily enough and it was rather a difficulty to keep up the supply of rats and mice; for, though they struck at, and killed, large rats introduced into their cage, possibly from fear, except on a few unique occasions they did not swallow them. I have always found mambas exceedingly shy of feeding when watched, I think that they realize they can be taken at a disadvantage so will not start to eat when anybody is about. I have surprised one with a dead weaver bird which it was swallowing, it dropped the bird at once to menace me.

Later, a *shamba* boy working in the Government farm at Kilosa, brought me a bright green 6-foot mamba in a watering-can, the mouth of which he had closed with a sack. It fed with avidity on dead rats and I came to the conclusion that being nervous of them the mambas probably prefer their food dead. My wife took this reptile home to the London Zoological Gardens where it lived for many years.

Curiously enough, on my return to East Africa in 1926, the first snake I saw was a mamba. I had left the train at Bahi and accompanied a local sportsman down to the river. Here he shot a buck and was running after it when a mamba shot across his path; five minutes later when quartering the cover he came up with, and shot, a snake which was apparently the same reptile. As I approached the bush in which it was, it darted forwards 3 feet (though shattered far back in the body near the tail), and struck at my stick most viciously. It measured over 7 feet but was far surpassed by a magnificent

specimen, some 10 feet long I should think, which was disturbed by Salimu, as it basked among some rocks at the foot of one of the Dodoma kopjes. It passed within 20 feet of me as it crossed some open ground and I had a good look at it. I must confess that I made no attempt to catch it, though it is the only snake that I have let depart. I returned next day to dig it from its retreat, but could find no trace of it.

When waiting for a boat home from Mombasa I called on someone who showed me a 7-foot mamba killed in a passage in his house! A truly unpleasant visitor. The largest male I ever measured was smaller than the captive females as it measured 2 inches under 8 feet.

Macharia, the Monyumwezi snake-catcher mentioned previously, certainly handled snakes in the most fearless manner. One day he walked into camp with an old pillow case containing cobras, a mamba over 8 feet long, Puff Adders and many smaller fry. He opened the bag a little and peered in, then shook it about a bit till the snake he wanted was uppermost, put his hand in, and drew out the mamba as coolly as possible. One day I received a message that Macharia, having been bitten by a mamba, was unwell and unable to report that week, but would come in a few days time. Frankly incredulous I set off on my cycle to his home five miles away. He certainly did look wan and sickly and on the back of his left hand was a nasty sore which he said was the site of the bite. I asked to see the mamba and he produced a 5-foot snake which, as I held it by the back of the neck, squirmed round so that its tooth came within an ace of scoring my thumb. It seems to me that the skin on the neck of a mamba is looser than on the average snake, they are certainly difficult to hold.

Macharia professed immunity to snake bites. He claimed that he allowed the young of poisonous species to bite him from time to time and also he scarified his limbs and trunk and rubbed in the broth resulting from a decoction of roots which he boiled. He always promised to bring me some of this but never did. The oversight was intentional, for some reason best known to himself. But though he could only be induced to speak of preventive methods with difficulty, he had no hesitation apparently in treating a native. Salimu, when some cobra venom alighted on his arm, exclaimed "Enough! It cannot hurt me, no snakes can." Then added

with a beaming and triumphant smile, "I've got Swahili medicine." "Salimu, how often have I told you that Swahili medicines are useless for snake-bites?" "Useless for Europeans perhaps, but good for natives." "Where did you get this *dawa*?" "When my father heard that you kept all these snakes, he feared that I might get bitten so he went into the bush and got the materials, scratched me all over with a needle and rubbed the *dawa* in." "Is that all?" "No Macharia did the same and gave some more *dawa*."

On being requested to produce it, he brought me a small packet of chrome-colored powder wrapped in a bit of ledger paper and sewn neatly up in a piece of black cloth to which was sewn a piece of string. The packet measured an inch by five-eighths by a quarter. This he said was to be worn round the arm. When I asked if I might open it by cutting the stitches he showed anxiety. "As you wish," said he, "You are a white man but something might happen." I paid him more than it had cost him for the charm, so that he might get another, but the packet mysteriously disappeared. I do not think Salimu took it, but Macharia may have instigated its recovery through other channels.

Gurukezi, also a Monymwezi, told me that after a pupil of the Wayeye has gone through the preliminary exercises he is taken out into the bush by the old snake doctors to locate a mamba, which, when found, he is told to catch; should he show fear, the snake doctors beat him with sticks until his fear of them is greater than that of the snake. Generally he gets bitten and is dreadfully ill but recovers after treatment!

Venomous Garter and Water Snake

The remaining species of elapine snakes occurring in East Africa belong to two genera each represented by a single species, if we consider that the black garter snake (*Elapsoidea nigra*) is only a color variant of Günther's garter snake (*E. guentheri*) as seems probable.

The typical form of Günther's garter snake is beautifully banded in coral-pink and white and is locally often spoken of as "coral snake." It is of course related to the American coral snakes (*Micrurus* spp.) and like them seems somewhat loth to bite. I nearly trod on one which was sluggishly winding its way through sparse herbage on the edge of the Parkland's Forest Reserve

at Nairobi. Its general color was grey but the twenty bands,—not rings as would appear at first sight,—were white with red centres. Another killed on Sixth Avenue was a quarter-of-an-inch under two feet; in its stomach were four lizard's eggs each measuring 8 x 4 mm. Is it possible that the snake had swallowed a pregnant lizard and that the gastric juice had not yet acted on the covering of the eggs?

The color form known as the "black garter snake" is somewhat rare except in the Usambara Mountains; in fact the only individual which I encountered in Kenya Colony was on the Uasin Gishu Plateau near the Burnt Forest. It was crossing the road just before dusk. I jumped off my bicycle and held it down with my cycle pump till I had a good look at it but as I had lost my way I had other things to think of than its preservation so I let it go. Two others were unearthed in an "ant hill" at Lumbo.

The black garter snake usually shows numerous narrow white bands along the whole length of body and tail; in some examples, however, the coloring appears uniformly black until the creature is annoyed when, by inflating itself, the white bands show up with startling suddenness. At Amani, where this snake is abundant, it appears to feed largely on caecilians. I recovered five of these batrachians from a snake's stomach there. They are very heavily infected with tapeworms and more rarely so with threadworms. The eggs vary from two to five in number and are enormously elongated; the biggest recovered from the oviducts of eight specimens, measured 40 x 10 mm. They are probably laid between November and January.

The venomous fresh water snake—*Boulengerina stormsi*—inhabits Lake Tanganyika and is becoming increasingly rare, I am told. I have never had an opportunity of collecting it or studying its habits, of which nothing is known.

II. HYDROPHIDAE

The black and yellow sea snake (*Pelamis platurus*) has been reported as occurring off the shores of East Africa, but all the cases I have investigated proved to be the vicious and poisonous snake-like eel *Muraena* or an allied species. The sea snake is more common on the coast of Madagascar.

(To be continued)

ABSTRACTS AND NOTES

THE PYGMY OR GROUND RATTLER

Reported cases of snake-bite, for which the Pygmy or Ground Rattler (*Sistrurus miliarius*) is responsible, are comparatively few. Yet this species must be held in some respect as several accidents, including one or two fatalities following its bite, have been recorded recently.

The following account is of some interest. It is abstracted from a report sent to the Antivenin Institute by Dr. F. E. Kauffman, from Clearwater, Florida. Dr. Kauffman wrote, "Yesterday (October 31, 1927) two brothers (8 and 11 years old) were brought to me approximately one hour after both had been bitten by the same rattlesnake (so-called ground-rattler here, two rattles and a button, length about 30 inches).

"Younger boy bitten first, about 15 minutes before the older one. This younger one was quite drowsy when they arrived. One dose of antivenin was all there was to be had at the time, so I administered half to younger boy first,

then the other half to the older one. In about 45 minutes more, one more dose was obtained at a town 8 miles away. I then gave half of that to the younger one first, the other half to the older one. I had fang-wounds well open and bleeding, then cauterized, before the antivenin arrived. Both victims now (24 hours later) doing well.

"One thing in connection with this incident is a bit unusual in this country. This snake was on one of the stone steps at a country school house where they were having a Halloween party. The younger boy was found crying, and when asked what was wrong, said something on the steps stung him. Then when the older one went to investigate, the snake had coiled again and struck him too. Just as this happened, a young man, who had just arrived and was coming up the steps, saw the second strike and trampled the snake to death before it could strike again. Both bitten boys were barefooted. One rarely sees a snake here in so public a place as that."

X ACTION OF SNAKE VENOMS ON THE DIFFUSION OF POTASSIUM, PHOSPHATES, HEMOGLOBIN, AND ON THE FORMATION OF LACTIC ACID IN VARIOUS ORGANS

By B. A. HOUSSAY AND P. MAZZOCCO

[Abstract and translation from C. R. de la Soc. de Biol., 95: 1509, December 17, 1926]

In a preceding note we pointed out that venoms produce the following changes in isolated muscle, in Ringer's solution: fibrillations; contracture; very rapid and strong imbibition; diminution, then loss, of excitability; diffusion of potassium and of phosphates into the liquid; formation of lactic acid; increase of phosphates and of lactacidogen in the muscles. These changes, except in part the first, depend on the hemolytic power and are produced by cytolysine.

The phenomena of permeability, imbibition, excitation and cytolysis have also been studied for other organs.

Cobra venom in the presence of a proper amount of the red blood cells of the dog, (10 to 20 per cent in saline 9:1,000) produces a gradual destruction (hemolysis), during which hemoglobin and potassium are found diffused in parallel proportions, whereas diffusion of phosphates is a little less regular. The diffusion of potassium and hemoglobin is not produced with the more resistant red-blood cells of sheep.

The same experiments were carried out with various organs, (kidney, liver, submaxillary glands, brain), of guinea pig, dog, sheep and frog. They were used entire, where possible, or if this was impossible, in pieces of equal size. In every case a greater diffusion of potassium and of phosphates was observed from the organs in the presence of venom. They exhibited almost always in comparison with the controls, a greater increase of weight, by imbibition, at the end of 1 to 3 hours. The liver and kidney treated with venom showed a greater increase of lactic acid, (method of Meyerhoff), than in the controls. In several cases no lactic acid was formed.

The venoms produced then, because of their cytolytic action, a constant and characteristic diffusion of potassium, a less regular but constant diffusion of phosphates, often an increase in the production of lactic acid. The diffusion of potassium is the best, sharpest and most general indicator of cytolysis.

X ACTION OF SNAKE VENOMS ON THE SALTS, THE REACTION, AND THE GASES OF THE BLOOD

By B. A. HOUSSAY, A. D. MARENZI AND P. MAZZOCCO

[Abstract and translation from C. R. de la Soc. de Biol., 95: 1510, December 17, 1926]

The action of venoms on the factors of coagulation has been studied *in vitro* and *in vivo*. After the injection of the venom of the South American *Lachesis* into dogs others have observed (1), an initial increase in coagulability, then a loss of the fibrins of the blood; (2), an initial leucopenia

followed by a prolonged leucocytosis; (3) the diminution of the red blood cells and of hemoglobin; (4) the almost complete annulation of the sedimented red blood cells; (5) diminution or disappearance of fibrinogen, diminution of the fraction of the plasma precipitated as globulin, and

an increase of that fraction precipitated as albumin; (6) hyperglycemia; (7) increase of the non-protein nitrogen and of creatinine; (8) slight increase of chlorides, the absence of marked variation of urea, creatinine, catalase, and alkaline reserve.

It has been demonstrated that non-coagulant venoms progressively diminish the resistance of the red blood cells while coagulant venoms produce first an increase followed by a decrease.

In our new series of experiments we used large (18 to 30 kilo) dogs, not anesthetized. Fourteen experiments were made with the venoms of *Lachesis alternatus*, *Lachesis newwedii*, and *Naja tripudians* injected intravenously in doses of 0.75 to 1 mgr. in the case of *Lachesis* and of 1 to 5 mgr. in the case of *Naja* (Cobra). The *Lachesis* venom produced an initial shock with hypotension, leucopenia, incoagulability, etc. In almost all cases the plasma became rose-colored. Hemoglobin diminished from 10 to 18 per cent in two hours. In the plasma, potassium increased from 15 to 35 per cent and the phosphates up to 40 per cent above their initial values. The chlorides increased very little. Calcium, sodium and magnesium exhibited slight, irregular variations.

In the venous blood oxygen diminished very much, and carbonic acid increased a little. This variation is due to

the circulatory slowing up, and to the capillary stasis, for the quantity of blood which passes per minute in the femoral vein diminishes considerably. In the arterial blood the diminution of oxygen is slight and parallels that of the hemoglobin. The carbonic acid varies little, but it diminishes very much in the case of intense polypnea.

The alkaline reserve falls at the moment of shock due to the venom of *Lachesis*, but after thirty to sixty minutes returns to normal or often a little above. The pH almost always increases a little, from 0.04 to 0.16.

We have measured the oxygen consumption by means of the Benedict-Roth apparatus, with graphs. During the shock due to the venoms of *Lachesis* there was a marked decrease, with return almost to normal in half an hour.

Three control dogs did not exhibit any of the variations observed among those which received the venom.

In résumé, after the action of venoms, we observed:

1. Hemolysis and diminution of erythrocytes;
2. Increase of the potassium and phosphates of the plasma, arising from the hemolytic products and perhaps also the tissues;
3. Transitory lowering of the alkaline reserve during the shock, with return to normal or elevation above.
4. Constant and slight increase of the pH, sometimes explained by the polypnea, but often inexplicable.

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